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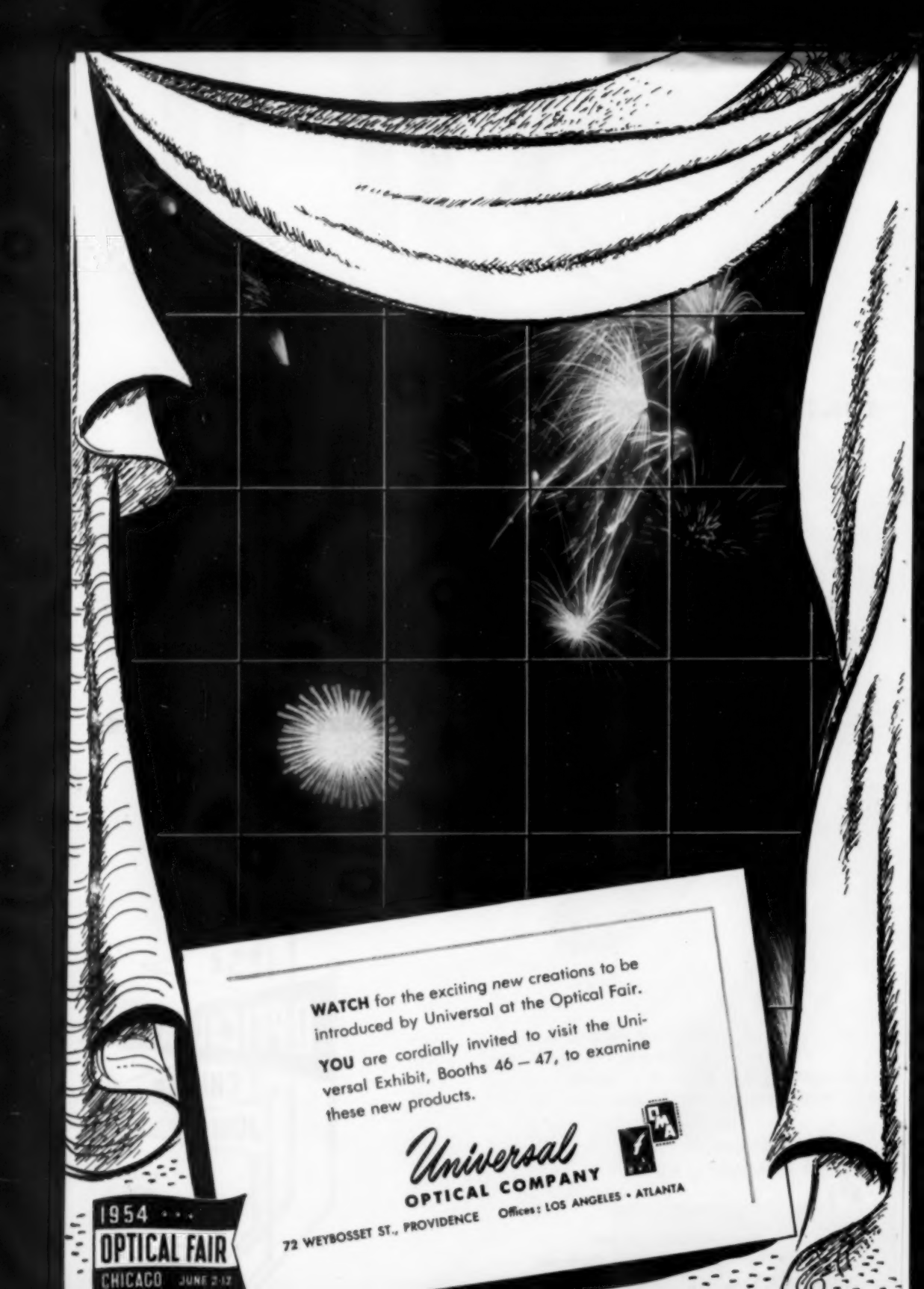
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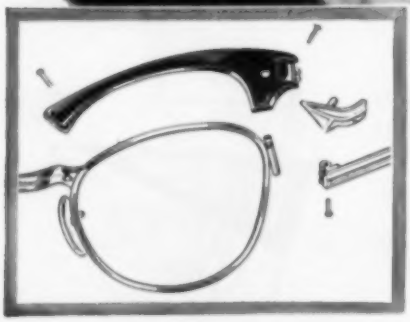

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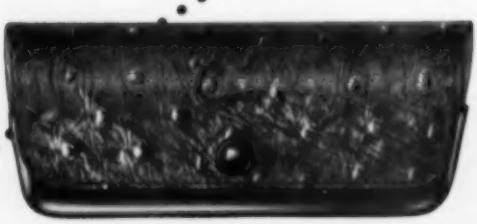

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THE CILIARY BODY IN ACCOMMODATION AND ACCOMMODATIVE-CONVERGENCE*

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Berkeley, California

In spite of the great many studies which have been made upon accommodative-convergence and accommodation, there are at least two fundamental questions which are without answers, namely: 1. In presbyopia is the loss of accommodation due entirely to the gradual sclerosis of the lens or is it due, at least in part, to some loss in the ability of the ciliary muscle to contract? 2. Is there fundamentally such a function as convergence-accommodation?

Alpern[1] has presented an excellent summary of the many studies made in the past in an attempt to answer the first question. As might be expected, since the question is still not settled, two major, not to mention many minor, conflicting answers have resulted. To quote from Alpern ". . . Gullstrand, Hess, Fuchs, Flieringa and van der Hoeve, and others (including Alpern) have supported the following theory:

"a. There occurs with age a decrease in the limit to which the lens can be made to change its form.

"b. In so far as the lens can be made to change its form, the same amount of ciliary contraction is required, at all ages, to produce a unit change in the form of the lens.

"c. As age increases it is to be expected that there will be an ever increasing excess amount of ciliary contraction beyond the power of the lens to respond to it.

"On the other hand, the theory implied in the writing of Donders and Landolt and formulated more completely by Duane and more recently by Fincham holds that the maximum amount of ciliary contraction is necessary to produce maximum accommodation at all ages. According to this theory either of the following may occur in old age: (a) a greater amount of ciliary muscle contraction is required to produce a unit change in accommodation than was previously required,

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†Optometrist, Ph.D. Member of faculty, Fellow, American Academy of Optometry.

or (b) the ability of the ciliary muscle to contract is diminished in some manner."

The writer has always been interested in this question since some of his own investigations have resulted in evidence for both points of view. In 1946 he proposed[2] that the mass of the ciliary body and hence the pull on the suspensory ligaments was due in part to the blood volume of the ciliary body. This theory offers an explanation for a decreased response of the ciliary muscle with age. Henderson[3] postulated that presbyopia is due to sclerosis of the connective tissue of the ciliary body. He postulated this cause of presbyopia since Duane[6] pointed out that the Helmholtz theory does not adequately account for presbyopia as being due to nuclear sclerosis while the lens cortex remains soft. However, if in addition to sclerosis of the nucleus of the lens and the connective tissue of the ciliary body we consider an accompanying decrease in mass of the ciliary body and loss of vessel elasticity due to the aging process presbyopia seems to be adequately accounted for within the basic frame work of the Helmholtz theory.

Duane[4, 5, 6] has presented the following evidence which he considers substantial proof of the idea that the contractility of the ciliary muscle must decrease with age:

1. Presbyopic subjects have as much difficulty in maintaining their maximum amplitude in action as do younger subjects. The physiological reserve of accommodation should increase with age and hence if presbyopes had any considerable reserve they should find it easier to maintain their maximum accommodation than do younger subjects.
2. There is an increase in amplitude of accommodation under binocular conditions as compared to monocular. This is extremely difficult to explain if one assumes any considerable amount of physiological reserve.
3. Homatropine is as effective, or more effective, in reducing the amplitude of accommodation in presbyopic subjects as it is in younger persons. The rate of action also seems to increase slightly. It is difficult to explain these observations on the basis of the physiological reserve idea.

The theory of accommodation stated above offers a ready explanation for a gradual decrease in the response of the ciliary muscle. It should be stated parenthetically, that Duane's observations are open to question. First, there is no evidence that presbyopes have greater difficulty in maintaining their maximum accommodation than do non-presbyopes. Second, the increase in binocular accommodation amplitude over monocular is merely proof of the truth of the Pythagorean Theorum. Third, the action of drugs is rather unpredictable and is dependent to a great extent on absorption rate, and other factors.

On the other hand, if the ciliary muscle does gradually respond less and less to the same degree of innervation, there should be gradual increase in the accommodative-convergence ratio. One would expect this to be so since the innervation to both functions (accommodation and accom-

modation-convergence) appears to originate simultaneously from the III nerve nucleus.

In order to investigate this possibility the writer and Peters[7] investigated the accommodative-convergence-accommodation (ACA) ratio in a group of two hundred presbyopic subjects. The mean ratio was found to be 3.8△/1.00 D. which is not significantly different from that reported in the literature for pre-presbyopic subjects.

Alpern and Hirsch[1-3] have given supporting evidence to this conclusion, their data indicating that if there is any change it is a slight decrease in the ACA ratio with age.

These studies, of course, tend to support the contention that there is no decrease in responsivity of the ciliary muscle with age. Apparently the only other explanation is that presbyopic subjects just do not make the necessary effort to accommodate, hence, in clinical studies where stimulus values and not response values are known, the ACA ratio is abnormally high. This might offer a rather logical theory since it is known that, on the average, the pupillary diameter in presbyopes is smaller than that of non-presbyopic subjects. This means that the depth of focus should be greater and, therefore, near objects should be clear even though the subject does not accommodate fully. The strange thing about this assumption is that if it is true then the amount of under accommodation must be just the right amount to show no significant change in the ACA ratio.

In 1950 the writer had an opportunity to examine the visual functions of a patient with Adie's Syndrome.[8] This patient had subnormal accommodation in one eye and the ACA varied depending on which eye fixated. Under these rather ideal conditions it was not possible to demonstrate any significant amount of physiological reserve of accommodation.

Thus the writer finds himself in the position of having found evidence to support both major answers to the original question.

The attempt was made to repeat Flieringa and van der Hoeve's[9, 10] original experiment using graduate students as subjects. The experiment was not successful because apparently the subjects when homatropinized would not, or could not, make any accommodative effort beyond their apparent measurable amplitude. It was also discovered that there was a considerable difference in the apparent amplitude depending on the testing method. For example, if the test chart were placed at a distance of 33 1/3 cms. from the 14 mm. plane the subject reported the chart was blurred and remained blurred no matter how hard he tried to clear it. Plus lenses were then added until the subject reported the print was clear. This lens power was then slowly reduced 0.25 D. at a time.

Under these conditions the subject might easily see the chart clearly with no lenses in place as long as he did not close his eyes. When instructed to look away and then back again the print again was blurred and remained so in spite of efforts to clear it.

The writer then decided to use himself as a subject. First, because after many years of work in binocular vision he has learned how to do "tricks" with his eyes and can apparently voluntarily accommodate or converge. Secondly, he is all too rapidly approaching the age of presbyopia and can truly be classified as a pre-presbyope. This may well be the critical time in the visual life of subjects during which they learn not to accommodate. The writer is impressed by his clinical experience of having presbyopic subjects state that they do not have asthenopia. Almost universally they either cut down on their near work or push it away from them.

As a preliminary study, the ACA ratio for each eye fixating was determined. This is shown in Figure 1. The accommodation response is stated with respect to the center of rotation of the eye.

Several things can be noted from inspection of Figure 1. First, the subject's amplitude measured by means of the optometer is on the average 5.50 D. This measurement should be compared to the subject's normal near point of accommodation as measured clinically by the push up method of Donders. This varies from 10 cms. to 11 cms. or 10.5 cms. on the average—thus the subject's clinical amplitude is very slightly in excess of 9.50 D.

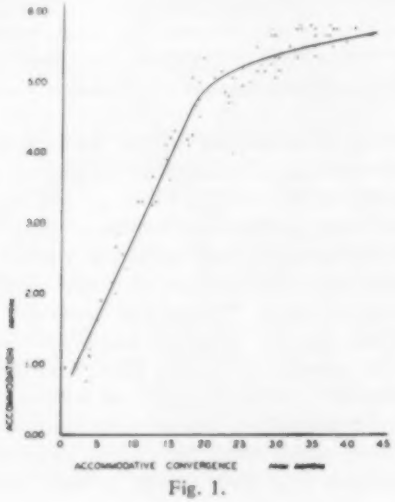

Fig. 1.

Secondly, the ACA ratio maintains a constant value of 4.2△/1.00 D. up to nearly 4.50 D. Beyond this there is a gradual increase in the ACA ratio until finally at the upper limit of accommodation the slope becomes nearly infinite. Is this flat portion due to reflex fusional convergence or is it due to accommodative-convergence? If it is due to accommodative-convergence, the slope becomes infinitely large because the lens does not respond to the innervation which is supplied to the ciliary muscle. The change in slope is probably gradual due to a gradual decrease in the response of the lens.

The writer attempted to utilize the whole of his accommodative effort without utilizing any reflex convergence. Thus if he succeeded, his maximum accommodative-convergence is between 40△ and 45△. If one assumes that the maximum is really the maximum ever attained, then this value is 43.5△. This is considerably less than his positive relative convergence which exceeds 65△.

If the assumptions made above are true then the maximum physiological limit of accommodation is 43.5 + 2 (to make up for the manifest exophoria at the zero level of accommodation) divided by the ACA ratio of 4.2. This amounts to slightly more than 10.8 myodiopters.

This theory can be tested by placing homatropine in one eye and measuring the accommodation and accommodative-convergence during the recovery phase. One drop of 10% homatropine was placed in the subject's right eye on two separate occasions. On the first occasion the homatropine was placed in the eye at 10:00 A. M. and measurements made approximately every half hour until 12:30 A. M. the next day. Data were recorded when a significant change in the amplitude became apparent. On the second occasion the homatropine was placed in the right eye at 12:30 A. M. Measurements were then made approximately every half hour from 8:00 A. M. until 6:00 P. M. the same day.

The observations as to the time of onset of the paralysis of accommodation and length of time an effect was noticeable agreed essentially with the observations of Duane mentioned above. The paralysis was nearly complete in less than thirty minutes and the effects were still apparent for more than 36 hours after the instillation of the drug. This contrasts with the effect in younger persons in whom a single drop does not cause complete paralysis.

Measurements were made at fixation distances equivalent to 1.00 D., 2.00 D., 3.00 D., 4.00 D., 5.00 D., 6.00 D., 7.00 D. and 8.00 D. The haploscope mirror before the left eye was covered so that the subject could not see the fixation target with this eye. The optometer on each arm of the haploscope was set conjugate to the retina for each eye, while

the right eye fixated the target. The two arms of the optometer were rotated so that the two optometer images were located one above the other on the same portion of the fixation target. Thus the accommodative response of each eye and the convergence induced for each fixation distance was determined in turn. The data were not recorded with respect to the fixation distance (stimulus values) but were recorded in terms of actual response of both accommodation and convergence.

Approximately every third hour the process was reversed and the left eye used for fixation. These data are not reported here separately since they were exactly like those for the right eye fixating.

Eight sets of curves were determined for the accommodation of each eye and the accommodative-convergence. Seven of these are shown in Figure 2. The one omitted was the one obtained during maximum paralysis. This response for the right eye was always at the zero level of accommodation. The ACA ratio was infinite. If these data were used subsequently it would involve multiplications involving both zero and infinity. The seven curves obtained for the left eye were nearly coincident. The curve drawn represents the mean response curve in each case. Each circle represents the average of not less than ten measurements. The average response for the left eye is shown. This is identical to that shown in Figure 1. The time after the insertion of the homatropine is indicated on each line.

The subject after doing this experiment can well understand the inability of others to successfully accommodate. It is very disconcerting to attempt maximum accommodation and not notice any clearing of the

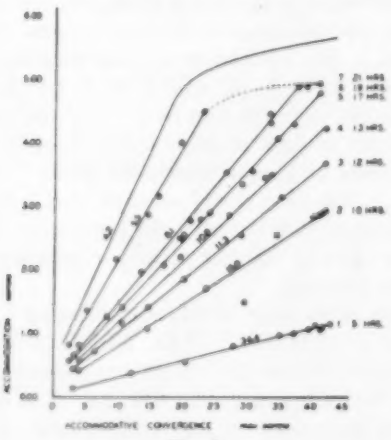

Fig. 2.

object. There is, however, a definite micropsia, when the response is tested monocularly. There is no subjective way other than introspection and "knowing" whether one accommodates or not.

The seven ACA ratios obtained, as well as the maximum amplitude for each curve, can be seen in Figure 2. These are shown below in Table 1.

TABLE I

Curve	*ACA*	*Maximum Amplitude*
1	34.4 △/1.00 D.	1.25 D.
2	15.0 △/1.00 D.	2.95 D.
3	11.3 △/1.00 D.	3.70 D.
4	10.3 △/1.00 D.	4.25 D.
5	9.0 △/1.00 D.	4.70 D.
6	8.1 △/1.00 D.	4.80 D.
7	5.5 △/1.00 D.	4.90 D.

The curves for the ACA ratios of 8.1 and 5.5 are not linear, especially the curve for 5.5. The 8.1 ACA line is linear to 37.5△ (39.5△) of accommodative convergence while the 5.5 ACA line is linear to 23△.

The total myodiopters in play can be determined from the ratio of the ACA for the right eye to the ACA for the left times the maximum amplitude obtained for the right eye. These products are shown in Table 2.

TABLE II.

Curve	*Myodiopters*
1	10.25 D.
2	10.33 D.
3	9.99 D.
4	10.20 D.
5	10.08 D.

In the case of curve 6 and 7, there is some doubt as to how to treat the data. It could easily be claimed that curve 7 should have reached the normal amplitude of 5.50 D. before it curved over to become flat. On the other hand homatropine may very well have some effect either directly or indirectly on the lens, capsule or ciliary body as well as at the myoneural junction so that the maximum amplitude obtainable under these conditions would be the 4.95 D. indicated. In the case of curve 7 there are no data points between 23△ of accommodative-convergence and 42△. This also makes the interpretation difficult.

In any event the amount of myodiopters present apparently for these two curves must be calculated as was the amount present in the left eye.

The inflection point for curve 6 occurs at 37△ of accommodative-convergence. There is a deficiency of 5△ in convergence to be accounted for. Over the linear part of the response there is a change of 8.1△ for each diopter. If this same rate holds for the balance of the curve, this 5△ represents 0.62 D. The accommodation at 37△ of accommodative-convergence was 4.80 D. Thus the total amount of myodiopters present is 4.80 + 0.62 = 5.42 D. The myodiopters for curve 7 calculated in a similar fashion is 7.95 D. Thus apparently the data in curves 6 and 7 are consistent with the other five.

It is interesting to note that the inflection point of curves 6 and 7 and the normal for the left eye is at about the same level of accommodation; namely between 4.50 D. and 4.80 D. This could be interpreted to mean that this amount of accommodation is readily obtained and that no more innervation is required to accommodate the first diopter of accommodation than is required for the third.

On the other hand, more effort seems to be required for the fourth diopter than for the first, second or third diopter. It might very well be that both schools of thought are correct in part. The Flieringa-van der Hoeve school is correct for the first portion of the total amount of accommodation while the Donders-Duane one is correct for the last portion of the amplitude.

It seems to the writer that this is a reasonable expectation even on the basis of logic without experimental evidence if one makes the basic assumption that the Helmholtz theory of accommodation is correct. The effect of sclerosis and other aging processes on the ciliary body and muscle would not be expected to act uniformly over the whole range of accommodation so that a constant percentage increase of effort would be required. It would be more logical to assume that the resistance would become more and more effective near the limit of contraction in the same way that there is an increase in resistance of any elastic body near its limits of stretch or compression.

There is one other problem associated with this experiment. Since the homatropinized eye was used for fixation and the subject tried to accommodate, it could be that convergence was voluntarily controlled and that accommodation varied through some reflex synergy with convergence.

Attempts to demonstrate convergence-accommodation have, for the most part, failed. It is true that accommodation does change near the limits of relative convergence. This change, however, occurs at the same rate as one would expect accommodative-convergence to become altered in aiding convergence.

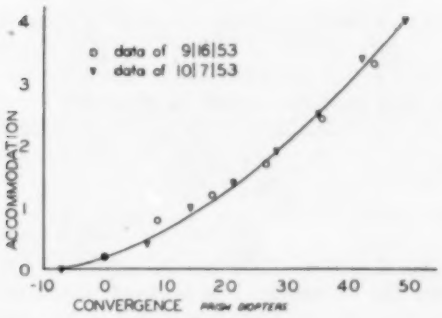

Fig. 3.

The problem involved with demonstrating convergence-accommodation is that associated with maintaining fixation but still allowing accommodation freedom to change. If accommodation changes by any significant amount, the fixation target becomes blurred. This in turn acts as a stimulus to alter accommodation to bring about a sharp image. Normally, then, the mere act of fixation dampens down changes in accommodation which might have occurred as a result of changes in convergence.

Recently Fincham[11] has proposed the theory that subjects increase their accommodation for a near object because convergence must be increased in order to see the object as being single. The reverse would be true for more distant objects. He reports the successful measurement of convergence-accommodation in two subjects.

A slight change in Fincham's technique was made in order to adopt it to haploscopic measurements. The apparatus used is shown schematically in Figure 4. Two sets of half-silvered mirrors were used as shown at M. The projection lenses, L, were such that their secondary focal points coincided with the entrance pupils of the eyes. The amount of accommodation in play was measured by means of the optometer, O, using the principal of stigmatoscopy. Two red filters with 1 mm. pin holes, P, were placed in the lens plane. The fixation targets, F, consisting of two concentric rings with suppression cues were colored green by placing a green filter behind them. The subject was placed in the haploscope so that the fixation targets, F, could be seen through the pin hole in filter, P. Since these targets could only be seen through the pin hole, the vergence of the incident light could vary over a large range without causing subjective blur. The optometer spots, O, were white. When these spots were not conjugate to the retina, the subject could see a small bright white spot in the center of a larger red disc. As the optometer spot

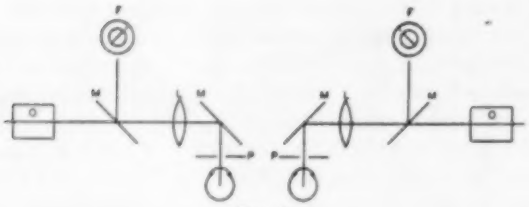

Fig. 4.

was made to approach a position more nearly conjugate with the retina, the size of the red disc decreased. The point of conjugacy was assumed to be found when the red spot exactly coincided in size and position with the small white spot seen through the pin hole.

The subject fixated the targets, F, and then adjusted the optometer, O. The convergence of the subject was then changed by changing the angle between the two arms of the haploscope. The subject then re-adjusted the setting of the optometer. For each convergence position at least five settings were made.

The field of view through the pin hole was extremely small and as a consequence most subjects exhibited a relatively small range of convergence. The results, using the author as subject, are shown in Figure 3. This subject exhibited the largest fusion range of any so far tested.

Inspection of this curve indicates that for this subject, at least, the two functions do not have a linear relationship. However, from about 15△ of convergence to 40△ the departure from linearity is small. The slope of this section is between 14△/1.00 D. and 15△/1.00 D. Thus the slope here is significantly different than the subjects ACA ratio of 4.2△/1.00 D. and consequently it is safe to assume that the measurements indicated in Figures 1 and 2 are due to accommodative-convergence.

These measurements lend some support to Fincham's theory of what starts the accommodative mechanism off in the right direction. They are not, of course, proof.

SUMMARY

The detailed haploscopic studies discussed here indicate that the ciliary body acts like an elastic body and that over most of the range of accommodation no more effort is required for each succeeding diopter than the preceding one. There is also evidence presented that the subject measured has a considerable physiological reserve of accommodation. This tends to support the theory of Flieringa and van der Hoeve. It has been determined that convergence does act as a stimulus to accommodation and that for one subject the values of the accommodative-con-

vergence accommodation ratio and the convergence accommodation ratio are different.

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ANNOUNCEMENT

REPORT ON CONFERENCE ON EDITORIAL PROBLEMS

A conference on editorial problems was held by AAAS. A review of the papers read at this meeting appears in the April 23, 1954, issue of SCIENCE. These are: Recommended Diet for Padded Writing: Does Writing Make an Exact Man: Probable Trends in Scientific Publications as Viewed from the Editor's Office: Problems in Financial Management of Scientific Journals: Problems of the Editor of a Small Journal: Illustrations for Scientific Publications: Jargon—Good and Bad, and Publishing as Applied Science.

This material is well presented and is most timely. It is recommended reading for optometrists working on State optometric journals. A copy of this issue containing all above papers may be had by writing, SCIENCE, 1515 Massachusetts Ave. N. W., Washington 5, D. C. The price is 25c, which should be enclosed with the request.

CAREL C. KOCH

OPTOMETRIC REHABILITATION OF THE PARTIALLY BLIND—A REPORT ON 175 CASES*

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About a year ago, a new so-called "High-resolution" lens for the partially blind was announced to the profession. It was my privilege to be invited to serve as one of the original panel of optometrists who were requested by the designer, Dr. William Feinbloom, to test the new lenses in our own private practices. The present paper summarizes briefly the principal findings of my clinical evaluation of the lenses.

A number of formidable difficulties were encountered, particularly in the earlier stages of the study. The unfortunate and ill advised publicity which succeeded the announcement of the lenses was strongly disapproved in professional circles, and resulted in widespread medical and optometric opposition which condemned the lenses sight unseen. The limited production of the lenses, which made it impossible to distribute them to more than a few specialists, was resented by many professional people, who felt that the lenses should not have been announced until they were freely available. Consequently, most of the patients who consulted their own doctors about the lenses during the early days of the study were given very little encouragement to investigate them further, or were advised against them.

The most formidable obstacle was the fact that, largely as a result of the publicity, many of the early patients expected such miracles from the lenses that the limited aid which they were offered seemed insignificant to them, and was rejected. Had their expectations been more modest, some of these patients undoubtedly would have accepted the lenses.

From the very beginning, however, the results that were obtained in those cases that were successful were most impressive. Typical of what could be done when the patient's cooperation could be gained by the doctor is the case of Miss S. A. She was 43 years old, and had optic atrophy produced by a brain tumor which had been removed in 1928. She had been unable to do any reading during the 24 years that had elapsed between the time of the surgery and her first visit to my office.

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When I examined her I found an acuity of O.S. 6/200, O.D. motion at 1 ft. At the near point, her acuity O.S. was measured on a Snellen chart designed for testing distance vision at 10 feet. On this chart she could read the 10/40 line at a distance of six inches. The letters she read were block capitals, 9 mm. square, with 2 mm. cross bars. The largest line on the Feinbloom near-point chart for subnormal vision patients has capitals 7 mm. tall, with 1 mm. cross bars. During her first visit in the middle of December, Miss A. was able to read the first two lines on the Feinbloom test chart with 6- and 8-power magnification. At the second visit in January she was able to read F3 and a 3rd-grade reader (12 point type) with 8-power microscopic spectacles. At her third visit in February, with the same 8X M.S., she was able to read ordinary book print, F4 (9 point type). At her fourth visit, on April 17, the 8X M.S. was dispensed. At this time, she was able to read F5 (8 point type) and a newspaper. Thus, her entrance distance vision, corrected or uncorrected, was 6/200, and her entering near-point vision, regardless of the scale by which it was measured, was so low that she had no useful reading vision; after a lapse of 24 years during which time she had done no reading at all, she was rehabilitated for near-point work and is now able to read books and newspapers. Incidentally, on the near-point chart devised by the Visual Press of Hollywood, copyrighted in 1950, the largest letters are about the same size as the 10/40 line on the 10-foot Snellen chart to which I referred above. On the Visual Press chart, the near-point acuity that this measures is listed as 14/224, or 20/320, or 6.8%.

A considerable amount of work needs to be done before a satisfactory set of standards for measuring subnormal visual acuities both at far and near are adequately formulated and standardized. One of Feinbloom's innovations has been a new distance test chart for subnormal vision patients, consisting of Snellen numbers from 20/800 to 20/175. These numbers are large enough so that the patient is given the encouragement of being able to read some of them, especially since the distance test is made at ten feet. The measurement of the acuity is more accurate with these charts than with the usual procedure of presenting a 20/200 capital "E" to the patient and bringing it closer to him until he names it. The familiarity of the typical subnormal vision patient with the Snellen test chart and the large Snellen "E" makes the conventional test somewhat unreliable.

The clinical studies that were made during the past year were made on 175 patients who consulted me as a private practitioner. However, a large number of these patients proved to be indigents, and con-

sequently it became necessary to make some provisions for following up the work on these patients and ensuring that those who could be aided were given help, regardless of their financial circumstances. Through the cooperation of the Board of Trustees of Chicago College of Optometry, a charitable foundation called the Chicago College of Optometry, Institute for the Partially Blind, was established under my direction. The funds contributed to the Institute were used to purchase subnormal vision aids for indigent patients, to whom they are furnished without charge for either materials or professional services. Through the generosity of the donors to the program, we now have on hand sufficient funds to provide for about 50 indigent patients, and we expect to continue with the program by raising more money through voluntary gifts. Several gifts have been made to the Institute by grateful patients because of their own first-hand knowledge of how much good the lenses can do for those who can be benefited by them.

The preliminary results on 175 patients studied during the past 12 months are reported in the tables and charts which follow.[1] Included in the data are preliminary reports on some of the indigent patients for whom the work will be completed through the Institute for the Partially Blind of Chicago College, and for whom delivery of their subnormal vision spectacles in some cases is being delayed in order to provide a predictable flow of patients for teaching purposes.

TABLE I

MAJOR PATHOLOGY	*No.*	*%*
Rentinal or Choroidal	81	46.4
Lens Involvement	35	20.0
Optic Nerve	28	16.0
Glaucoma	12	6.9
Cornea	7	4.0
Idiopathic	5	2.8
Physical Anomalies	4	2.3
Retro-lental Fibroplasia	3	1.6
Total	175	100.0

Table I. shows the distribution of pathology. There was apparently no correlation between the nature of the pathology and the prognosis of success, but rather, the significant factor was the amount of damage to the vision which had been produced, and the relative speed at which further deterioration could be expected to take place.

[1]I am deeply indebted to Dr. Herschel Stroud of Kansas City, who served as my assistant in working with all of the patients studied, and who prepared the tables and charts used in this report. His assistance in this project was invaluable.

Retinitis pigmentosa, diabetic retinitis, retinal hemorrhages, and retrolental fibroplasia seemed to produce the most difficult conditions with which we worked, either because of their progressive character or because of the severity of the damage which they had caused.

Some patients in each group were aided, including one in the retrolental fibroplasia group, a 7-year-old boy with 4/200 vision. The boy had been in a sight-saving class, but was scheduled to be transferred to a Braille school because of the great difficulty with which he deciphered the sight-saving texts (24 point type). With a 6X M.S., he was able to read 12 point type, from a 3rd-grade reader, and to read his sight-saving text with ease. His sight-saving teacher made a trip to the college so that she too could express her gratitude for the program which made this result possible. The boy's spectacles were contributed by the Institute for the Partially Blind.

TABLE II

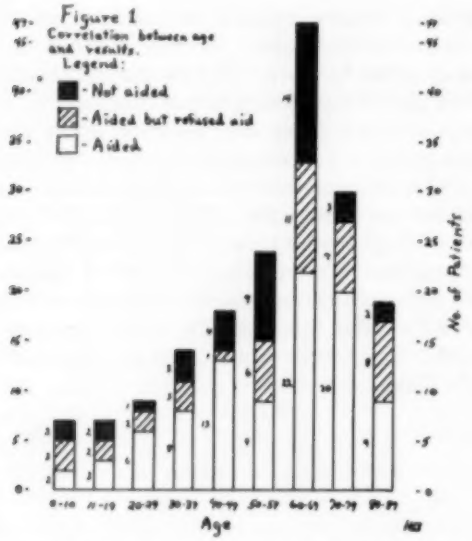
VISUAL AIDS USED

Aids	*No.*	*%*
2X MS	4	2.7
3X MS	1	0.7
4X MS	30	20.3
6X MS	37	25.0
8X MS	27	18.2
10X MS	8	5.4
12X MS	4	2.7
14X MS	4	2.7
16X MS	0	0.0
18X MS	1	0.7
20X MS	2	1.4
2.2X TS	17	11.4
3X TS (Wollensack)	3	2.1
Regular Spectacles	10	6.7
Total	148	100.0

Note: MS = Microscopic Spectacle.
TS = Telescopic Spectacle.
For two patients cylindrical power was incorporated into Microscopic corrections.

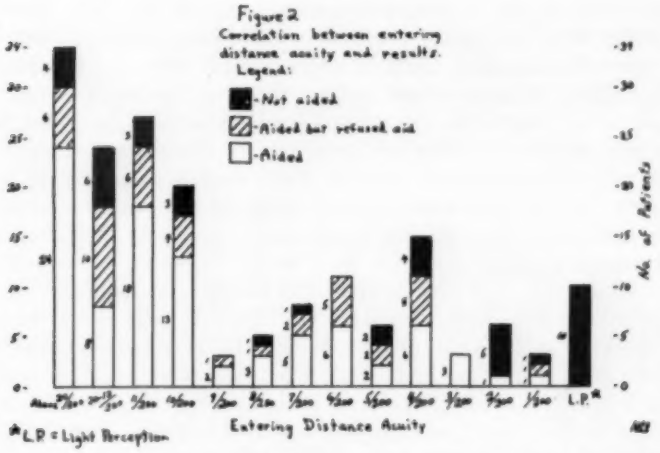
From Table II., which summarizes the visual aids used, it is apparent that for the beginner in the field, the 4X, 6X, and 8X M.S., and the 2.2X T.S., would comprise an adequate minimum test set. I would also recommend the 3X Wollensack T.S. as a useful addition to the beginner's test set. There seems to me to be a real need for a 3X T.S., if one could be designed which would offer the compactness and good cosmetic design which makes the Feinbloom 2.2X T.S. noteworthy. There is no question that many more telescopes would have been prescribed, had a 3X T.S. of superior cosmetic design been available.

About half of the *regular* spectacles which were prescribed were



simulated microscopic spectacles of 16 or 20 diopter power used monocularly, as is the M.S. As the chart notes, for only two patients was it found advisable to incorporate cylindrical power into microscopic corrections. In both a substantial improvement was found. In one of these, an extremely photophobic arrested glaucoma patient, a calobar D tint was also incorporated into the microscopic correction.

An analysis was made of the possible relationship between the age of the patient and the results obtained, which are shown in Figure 1, and the entering distance acuity of the patient and the results obtained, which are shown in Figure 2. It is difficult to find any significant correlations revealed by either of these charts. Perhaps the most significant item on either chart is the number of patients in any category who could be aided but refused to accept the help that was offered. In the age group from 6 to 10, three of the five children who could be helped were either considered to be too young, or had difficult adjustment problems, which made their parents feel that it would be wise to postpone the work until they were older. In the group between the ages of 80 and 89, the percentage of those who refused aid was slightly higher than that in other groups, which is understandable because of the increased difficulties encountered here, such as palsy, apathy, and a fixity of habit pattern. Figure 2 reveals no significant correlations between those who could be helped but refused aid, and the entering distance acuity. It was noted



that many of the patients who had the greatest obstacles to overcome worked with the most persistence and determination to achieve normal reading; where others who could read 6 point type with microscopic spectacles without training, and with ease, rejected the aid despite the fact that no effort would have been required to achieve a successful result.

Obviously, the most important factors which determined whether or not aid was accepted, are not shown on the charts, namely the skill and experience of the doctor, and the personality of the patient, his outlook on life, and the kind of adjustment he had made to his handicap. There were some patients who refused aid because of an obvious reluctance to give up the helplessness which made them the center of attention in the family. These people could achieve, but preferred to withdraw into the shelter of what might be termed the "*dependent* blind personality." Many patients refused aid for reading as not being the kind of aid they wanted. This occurred not only with the first patients who were misled by the publicity, but with patients to whom the limitations of the lenses had been thoroughly explained, and who had agreed that they were not going to expect anything more than reading help. However, when reading vision was obtained, the very fact that these people could be helped in this one fashion, seemed to increase their disappointment at not being able to obtain help for what they consciously or sub-consciously wanted most of all, an improvement in ambulatory distance vision. Consequently they could not bring themselves to accept the "half a loaf" which was all that we could give them. Others had vocational requirements which could not be met under the limita-

tions with which microscopic spectacles are worn. One man, for example, who was an engineer and who inspected steam boilers for a fire insurance company, could be given reading vision for 6 point type, at a working distance of two inches. However, his single concern was to get enough help to be able to read the serial numbers on a hot boiler, at a safe distance, and this aid could not be offered to him, even with telescopic spectacles, which did not afford enough magnification for his purpose. He was quite uninterested in using the M.S. for general reading, as he preferred to have his wife travel with him and do all of his reading and writing for him.

Others who had been successful in hiding their handicap behind a concealed hand magnifier, preferred not to reveal their partial blindness by working at the close distance which the microscopic spectacle demands, and for the same reason they would not wear telescopic spectacles with a fit-over because of the attention which this device called to their reduced vision. Some patients had operable cataracts, and while they could have been helped temporarily by microscopic spectacles, surgical intervention was urged instead.

Some of the very high myopes had, of course, good reading vision without lenses and would not accept telescopic spectacles even though their distance vision was improved, either because they were unwilling to wear disfiguring spectacles, or because they were unwilling to accept the restriction of using them for non-ambulatory purposes only.

Occasionally a patient was encountered who had been advised by his ophthalmologist to use his eyes sparingly so that he could "save" what vision he had left. Such patients were usually afraid to use subnormal vision spectacles for fear of making their eyes worse. One such patient said that he would accept the microscopic spectacles provided we would take all responsibility for any further loss of his vision which he might suffer from that time on. He was 58 years old, with retinal hemorrhages O.U., and a distance acuity of 10/175 O.U. With a 4X M.S. he could read with ease any test type we had in the office, including 3 point type. With his hand magnifier he could read F3 and F 4 syllable by syllable.

His proposal was, of course, rejected. I suggested that he go back to his ophthalmologist and also check with two or three other noted ophthalmologists who, I assured him, recommended the microscopic spectacles for patients with similar pathologic conditions. Despite the fact that he had exhibited a considerable degree of nervousness and worry about the imminent prospect of being forced to discontinue his work as an accountant, and his elation at the prospect the lenses afforded for enabling him to continue with his work, he never reported back.

TABLE III

NEAR POINT ACUITY ACHIEVED *Acuity*	*No.*	*%*
F5*, 8 point type, 20/50, Newspapers	129	73.8
F4*, 9 point type, 20/60, Magazines	5	2.7
F3*, 12 point type, 20/80, Books, ages 9-12	1	0.5
Light Perception	10	5.7
Magnification did not help	22	12.6
Blind Personality—Refused all aid	8	4.7
Total	175	100.0

*Notation of type size—Feinbloom Subnormal Vision Reading Card.

Table III. shows the near-point acuity which was achieved. All but six of the patients who could be aided were able to read newspaper print (8 point) type. Five of these six could read magazine type (9 point), and one could read 12 point type. Ten patients who had light perception only should have been screened out as ineligible for testing before they were admitted as patients. In some instances, these patients had medical reports that were out of date; in others, the patient or his family urged us to do the screening for them. Twenty-two patients representing 12.6% of the total, did not seem to be helped by magnification. The eight patients representing 4.7% of the total, who were classified as "dependent blind personality" refusing all aid, were typically able to read 8 point type, while protesting either that they could not see a thing, or that they were suffering great pain, or that the effort was too much for them.

TABLE IV

RESULTS IN TERMS OF USABLE RESOLUTION	*No.*	*%*
Patients who could achieve usable resolution	135	77.0
Patients who could not attain usable resolution due to pathological reasons	32	18.3
Patients who could not attain usable resolution due to psychological reasons	8	4.7
Total	175	100.0

Table IV. summarizes the findings in terms of usable resolution for reading and indicates that 135 patients, representing 77% of the total, could achieve usable resolution; while 32 patients (18.3%) could not be helped, and 8 patients (4.7%) were psychologically incapable of being helped.

The final results are tabulated in Table V., which indicates that 92 patients (52.5%) were aided and accepted the aid offered; 43 patients (24.5%) were offered aid but did not choose to accept it. The

TABLE V

FINAL RESULTS

	No.	%
Aided*, and aid accepted	92	52.5
Aided, but aid not accepted	43	24.5
Not aided	40	23.0
Total	175	100.0

*Range of best entering distance VA in group that achieved aid: 20/2000 to 20/50.

43 patients who could be aided but did not accept the aid offered represented 32% of all the patients in the aidable group. 40 patients (23%) could not be aided at all.

In conclusion, it is the opinion of the writer that the new clear image lenses have extended the range of aid which can now be offered to the partially blind, and that with their aid the specialist can help many people who have formerly been told that nothing could be done for them. This is particularly true where higher magnifications are required for reading than can be obtained with telescopic spectacles and reading fitover adds. It should be borne in mind, however, that many of these same people could have been aided by the easily available earlier form of microscopic spectacles, or even by high plus spectacle lenses, such as 16 or 20 D. lenses. However, the newer lenses are definitely preferred by those patients who are offered a choice.

It was not the purpose of the foregoing study to determine whether or not an equally high percentage of success could have been obtained by means of other devices than those used. No controls were set up to investigate such a problem, which would require a much more elaborate study than the time and funds which were available would have permitted.

We have already noted that 32% of the total group who could be aided by the lenses did not accept the aid which was offered. Various reasons for these failures were briefly reviewed, and for the most part they illustrate the importance and the difficulty of establishing a good rapport with the handicapped person, without which rehabilitation can not be effected. Other failures, however, were very clearly traceable to the apathy and maladjustment of the patient, and emphasize the great need for further study of the basic psychological problems of the partially blind.

I would certainly recommend that the subnormal vision specialist should work in close cooperation with a good psychotherapist, and

should learn enough about psychotherapy to know when his patients need special help.

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ANNOUNCEMENT

DEUTSCHE GESELLSCHAFT FUR OPTOMETRIE

The German Association for Optometry will hold its 6th annual Congress in Berlin, September 20-25, 1954. Dr. Peter Abel is chairman, and Dr. Carl-Heinz Nitzschke is Congress secretary. The first two days of the Congress period will be devoted to clinical instruction and the final three days to the presentation of papers by German, Danish and English optometrists. Optometrists from the United States and Canada are invited to attend. For particulars write to the secretary, Dr. Nitzschke, Detmolder Strasse 66, Wilmersdorf, Berlin, Germany.

READING — A DEVELOPMENTAL AND EDUCATIVE PROCESS*

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Reading may have a different meaning to different people, but it is generally accepted as the most important form of communication. Reading is the primary link between the individual and all printed sources of knowledge and information. Through reading one may increase his understanding of the world in which he lives as well as his understanding of himself. Reading also provides the primary means for continuous self-improvement and is in no small way an important leisure time activity of both children and adults. For some individuals reading may become an escape at times. It is a well-established fact that academic success at all levels of education is dependent primarily upon reading proficiency; therefore, reading means academic success to some people. Clearly, these concepts explore only a small portion of the many interpretations people place on the role of reading in their lives.

As the individual develops, so should his reading habits show signs of maturation and progress. To develop mature reading habits is a long range developmental and educative process that is an important part of the individual's total growth and development. Through years of research and experience psychologists and educators better understand now the nature of the reading process. Reading formerly was conceived as the rather limited process of being able to recognize the word and say it correctly. Mastery of reading, then defined as correct *word-calling* or *word-naming*, was believed to require only about three years of training, and so reading instruction became an important part of the curriculum only for the first three grades. Children were supposed to *learn to read* in the first three grades and after that they were to *read to learn*. Too often it was assumed that children mastered the reading process in these primary grades; after this stage of development it was merely a matter of providing practice and time for reading. Practicing with immature or undeveloped habits was of little benefit, although reading training was usually terminated at the end of the third grade when mastery of

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†Director of Reading Service.

reading was believed to be a completed process. This early concept of reading was quite unconcerned with interpretation, reaction, and application as necessary stages in the development of effective reading habits.

Reading now is defined more broadly. Today, reading authorities agree that reading includes not only the recognition of the printed symbols, but also *interpretation* or understanding of the concepts which the symbols convey, *reaction* to the material read, and finally *application* of the ideas and information obtained from printed pages. Reading, as is implied in this definition, is a process consisting of not one skill or technique but many related skills that must be trained and developed over an extended period of time. No longer is reading thought to be solely the responsibility of the primary grades, but rather the development of mature reading habits is a *continuous process*, beginning early in life and extending into adult years. There are stages of growth and development in reading that take place at each level of advancement. The skills and understandings involved in the reading process are not segmented or segregated at any one grade level; nor is one teacher any more responsible than another teacher for the instruction of effective reading habits. It is just as important for an eighth grade teacher to provide instruction in improved word recognition skills, so that students can overcome any difficulties in this aspect of reading and become more independent in using these skills at more advanced levels, as it is for primary grade teachers to be responsible for teaching certain skills of word attack. Likewise, teachers of college English must continue to teach their students how to develop more effective and rapid habits of interpretation than were required in their literature classes in high school. From the primary grades well into adult years, one of the basic skills to be developed is increased flexibility in reading. Just as the reader must develop this flexibility, so must he constantly understand the greater variety of purposes for which he reads. Greater flexibility is achieved by learning to adjust reading rate and comprehension in accordance with the reader's particular requirements for reading and the type of material. A flexible pattern of reading can best be achieved through a program which stresses more diversified reading.

This development of more mature reading habits from childhood into adult life is absolutely essential as a person's reading demands and needs become more advanced and as he lives in a more complex world. His *reading needs* are constantly increasing. A typical individual has a variety of reading needs, such as to read his study or work-type materials for thorough understanding, to skim or "scan" certain other materials, and to read purely for appreciation and enjoyment. When an individual is successful in satisfying his various reading needs, he not only achieves

at a higher level, but he has a greater sense of accomplishment and derives increased pleasure and enjoyment from his reading. Consequently, reading is now being taught in grammar schools, high schools, colleges and universities, adult education programs, and business and government training programs. Actually one of the most predominant trends in the teaching of reading today is to extend reading training programs upward to more advanced levels of education.

Increased reading achievement is dependent upon a number of related factors, as well as specific instruction in good reading habits. These related factors include mental capacity, visual skills, personality, and interests. Appraisal of reading proficiency should be based upon an evaluation of a person's reading skills and related factors, inasmuch as these factors most directly affect an individual's reading achievement. All of these factors are interrelated, and difficulties in any of them will influence the development of the reading process. For example, inadequate visual skills for effective reading growth may keep the learner from developing adequate habits of word recognition. This retards his reading achievement which may lead to feelings of inadequacy and anxiety.

Several years ago a boy, who was then a sophomore in a Chicago public high school, came to the Reading Service at Illinois Institute of Technology for a diagnostic examination of his reading. He was given tests to aid in an evaluation of his mental capacity, reading skills, visual skills, personality, and interests. The results of the diagnosis indicated that he had above average mental ability, very inadequate reading skills for his capacity and grade level, and a great deal of difficulty with visual skills tests of fusion and coordination. Findings in the area of personality revealed strong feelings of inadequacy, sensitiveness, indecision, and a marked tendency to worry. His interests were restricted primarily to mechanical and technical areas. The boy and his parents were counseled on the diagnostic results, and it was recommended to them that he should have a thorough visual examination before he could enroll for reading instruction at the Reading Service. A complete visual examination revealed a serious fusion and coordination problem of the two eyes, and the eye doctor recommended a program of visual training to precede the reading instruction. Due to the nature of the visual difficulty in this case, it was the doctor's recommendation that the boy must improve his visual mechanism before he could derive maximum benefits from the reading training. After several months of visual training, the doctor recommended that this boy should start his reading training. Although he had almost completely corrected his visual problems, and was visually ready for the reading instruction, he had not corrected his poor reading habits. He then started an intensive program of reading training, which

included instruction in the skills of word recognition, vocabulary meanings, and comprehension. As his reading improved, so did his self-confidence, steadiness, and general contentment. Once this boy became a better reader he sought vocational counseling to help him to better understand his aptitudes and interests, which were changing as his reading improved. The case history of this boy is reported to further emphasize the fact that parents, teachers, and other specialists interested in reading must always consider reading, not in isolation, but in relationship to the other factors which so greatly influence reading achievement at all age levels.

Today more than ever before we realize that all people do not have equal ability to learn. People vary in their capacities and abilities to achieve. Since reading is a learning process, people at all ages will vary in their ability to learn to read. An individual is capable of reading achievement of a quality commensurate with his verbal mental capacity, since the verbal factor is by far the most important factor in mental ability so far as progress in reading is concerned. Critical and creative reading should always be encouraged on a level commensurate with ability. Therefore, all teachers, as well as all teachers of reading, must take into careful consideration the individual capacities and potentials of their students. This concept does not preclude working with students in groups. Anyone who is not reading up to his capacity has *developmental reading needs*. He is a retarded reader in the sense that he has the potential for improved reading achievement. One of the serious problems today is the large number of high school and college students and adults whose reading achievement is not up to their potential ability. This problem emphasizes the need for more developmental reading training adjusted to individual needs and capacities over a sufficiently long period of time.

Reading is a learning process comprised of many skills. These skills may be classified in four major categories: (1) word recognition, (2) vocabulary meanings, (3) comprehension, and (4) speed or rate. All four of these aspects of reading are essential for proficient reading, whether a person is reading social science or scientific materials, and will vary in their application only according to the circumstances surrounding the particular reading situation. Increasing proficiency in all four of these aspects of reading comprises an individual's *reading capability* which in a school situation he applies to read and to understand history, geography, language, and other subjects that involve the ability to read. Likewise, the adult uses his *reading capability* to execute his job effectively and efficiently and to satisfy his personal reading needs and interests.

It has been stated earlier that reading growth is a continuous *developmental process.* In an effort to better understand this educational process it might be well to describe briefly the various stages of reading development. One of the basic concepts to be fully understood is that of *reading readiness.* Too often readiness to learn to read is thought of only in connection with children who are entering the first grade. However, reading readiness is not a concept to be confined only to the first few grades, but it is an important concept at all stages of development. Readiness must exist at all levels for effective teaching of reading as well as effective teaching in all areas. Broad experience and a good oral language background are two essentials for learning to interpret printed symbols in reading. Also essential at all levels of reading training is the use of interesting and understandable materials. If an individual does not enjoy what he is reading, he will have little motivation or "drive" to improve his reading.

Modern methods stress the development of word recognition, or word attack, skills in teaching children to learn to read. The principal job in the primary grades is to teach children how to recognize words independently, to devolop their reading vocabulary, and to provide instruction in a variety of skills that will aid them in getting meaning from the printed page. In the intermediate grades children are confronted with many more polysyllabic words, and instruction continues in phonetic principles and structural analysis of words to further develop their independence in word recognition skills. Emphasis continues to be placed on further vocabulary enrichment. Instruction is provided in more complex skills of comprehension to prepare children to better interpret the more complex ideas encountered in the content subjects. They are taught to read not only for the literal and sense meaning but for the broader and implied meanings as well. In this stage of development emphasis is placed upon learning to read in phrases or meaningful units of thought. There is a decreasing emphasis on oral reading and an increasing emphasis upon more rapid silent reading. *Visualization* of meaning becomes an increasingly important aspect of more mature reading habits. The ability to visualize meaning may be seriously retarded by persistent habits of vocalization and word reading, as well as a lack of adequate word recognition, vocabulary, and comprehension skills.

By the time students enter high school they should have developed a certain degree of maturity in their ability to apply their reading habits. However, the need still exists for further reading growth or achievement to continue. Greater reading maturity is required in high school, college, or on the job than a student has attained when he enters high

school. Just as a course in mathematics is now a part of the general curriculum in high school, it is entirely possible that in several years a reading course also will be a required subject for high school students. It is the responsibility of schools, colleges, business, and government to provide the opportunity for people to advance in this important learning process through definite, systematic training in reading.

It is a well known fact that many adults today have not developed reading habits commensurate with their mental power or capacity. The causes and reasons are numerous, but the primary cause is a *lack of training* over an extended period of time. Reading instruction for those who are adults today was terminated at the end of the third or fourth grade, and consequently many adults have taken their undeveloped reading habits to jobs demanding greater reading effectiveness. However, the recognition of reading as a developmental, life-long process has resulted in an increase in the facilities available for training adults to become more proficient readers after they are out of school.

One of the basic difficulities which adults experience in their silent reading is slow word-by-word reading habits. They actually may *vocalize* each word and sometimes even syllables. When an adult moves his lips while he reads silently, his mind has to laboriously grind out the meaning. Visualization of meaning becomes practically impossible because the eyes perceive only words or parts of words, and the brain in turn receives only isolated words and syllables to translate into meaningful concepts. Even when lip movement is suppressed far too many adults *see and think* only one word at a time when they read. The mature habits of interpretation, reasoning, and thinking that should accompany reading are relegated to the background. When word-by-word reading is suppressed and the person learns how to read in meaningful thought units, the rate of reading becomes the function of the *rate of comprehension* and the *rate of perception*. He is then able to grasp the meaning and significance of the larger concepts, or the "whole" of what he is reading, proceed from this understanding of the whole structure to a more detailed analysis of the parts, and finally summarize the meaning by combining the parts into the whole again. Likewise, retention of meaning as well as understanding at a faster rate is greatly facilitated.

In summary, reading is a learning process comprised of many skills. The development of this process is affected by a number of related factors. Effective, mature reading habits result only from recognition of these related factors and are promoted by developmental training extending from early childhood into adult life.

THE SUPPRESSION THEORY OF BINOCULAR VISION*

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HISTORICAL NOTE

The Suppression Theory is of ancient origin. It was clearly described by du Tour in 1860, before there was any knowledge of depth perception due to disparity of the retinal images. It was considered by both Wheatstone (1838), who invented the stereoscope, and Panum (1858), but was rejected as it was thought to be incompatible with singleness of vision from disparate stimuli. More recently some, including Verhoeff, have supported similar ideas. However, Verhoeff's views differ in one fundamental way from those outlined below, in that he did not believe in the rigidity of correspondence.

STATEMENT OF THE SUPPRESSION THEORY OF BINOCULAR VISION‡

In normal vision, the correspondence of the retinal elements is completely rigid and unchanging.

One of a pair of corresponding points always suppresses the other.

Where there is a contour, the suppressing power of retinal elements on each side of it is enhanced.

Where there is disparity of contour, then in the one eye retinal elements on both sides of this contour will suppress corresponding points in the other eye.

If the extent of the suppression is smaller than the disparity between the contours, then diplopia occurs, but depth perception is possible.

If the extent of the suppression is greater than the disparity between the contours, one contour is suppressed and single vision occurs with depth perception.

The contour of one part of the image may be dominant in one eye, and that of another part may be dominant in the other eye.

DEFINITION OF CORRESPONDENCE

Suppose one eye views a dot and the other eye views a circle and that the eyes are so directed that in the combined view, the dot appears to be

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‡"Statement of the Suppression Theory of Binocular Vision" appeared in the British Journal of Ophthalmology, Vol. 37, page 37, 1953.

in the centre of the circle. By the definition proposed here, the point on the one retina receiving the image of the dot corresponds to the point on the other retina receiving the centre of the image of the circle.

Similarly, suppose two dots are marked some distance apart on a piece of graph paper, and on a second piece two circles may be drawn so that their centres fall on portions of the graph paper which correspond in position to the places occupied by the dots. If in the binocular combination, each dot appears in the centre of its circle, then corresponding points on the two retinae are those which receive corresponding parts of the squared pattern of the graph paper. The second circle and dot are introduced in order to define the position of the two eyes with respect to a relative rotational movement about the visual axes (cyclophoria).

This definition is equivalent to saying that corresponding points are those which have the same visual directions.

FIRST PHENOMENON OF SUPPRESSION

CONTOUR IS DOMINANT TO UNIFORM BACKGROUND

Consider the case of a black parrot seen by one eye and a black cage seen by the other, each surrounded by a black frame. In the combined picture both parrot and cage appear as black as the frame. Thus there is complete suppression of portions of the white ground which correspond to parrot and cage in the opposite eye.

This experiment proves that people with normal vision can suppress simultaneously in both directions. If suppression were not a normal accompaniment of vision, it is unlikely that it could occur spontaneously for the first time when a person first combines such a pair of diagrams in a stereoscope. The suggestion is very strong that such suppression is a part of the normal visual process.

It is the proximity of each part of the parrot or cage to its own outline (contour), which enables it to suppress the corresponding portion of white ground.

In the same way, an object held near the face will be seen in crossed diplopia against a uniform background, and each of the two images will completely suppress the portions of the uniform background falling on the corresponding points of the opposite eye.

SECOND PHENOMENON OF SUPPRESSION

SUPPRESSION OF ONE CONTOUR BY A DISPARATE CONTOUR

When, in the combined mental impression, lines from a picture seen by one eye come close to lines from the picture seen by the other eye, then there will be suppression of part of one figure by the other. When the direction of the suppression alternates there is said to be rivalry. One example is given by a binocular combination of a vertical bar with

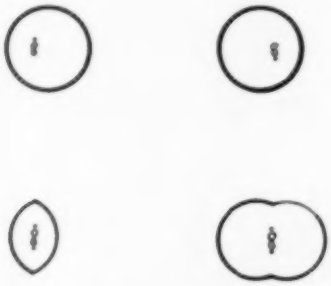

Fig. 1.

a horizontal bar. Another is given by small control marks placed in between alternate lines of Snellen Charts reduced in size to fit a stereoscope. One card carries marks under the 1st, 3rd and 5th etc. lines, the other under the 2nd, 4th etc. lines. The marks are seen to come and go when viewed by people with normal vision.

This phenomenon makes it harder to see an animal in a cage drawn with bars than in one drawn only in outline. If the exercise is one for treating convergence defects, the cage should not have bars, if an amblyopia or an abnormal suppression is being treated, there is certainly a case for using cages with bars, thus training suppression in different directions from closely adjacent portions of the binocular picture.

Abnormal or pathological suppression occurs when the suppression is in one direction over a large area. In normal vision the binocular picture is a mosaic built up from parts seen by one eye and parts seen by the other.

In bar reading the patient is trained to suppress the bar, first in one direction, then in the other.

The great importance of the second phenomenon of suppression is that it enables singleness of vision to occur when the retinal images are disparate.

The following example, Figure 1,* will demonstrate how disparity, suppression, and depth perception, all take place without change of correspondence (as defined) of the retinal elements.

A figure 8 is drawn in a circle, offset to the left of the center in the left eye view and to the right in the right eye view. Control marks above and below are added to ensure accurate fixation. When the 8 is fixated it is never seen in the center of a true circle, but careful observa-

*Figures 1 and 2 have appeared in the British Journal of Ophthalmology, Vol 37, page 37, 1953.

tion shows that it appears inside a circle which is distorted in one of two ways. If a dotted vertical line is drawn through each 8, then each circle is divided into a small temporal half and a large nasal half. The combined figure is either a narrow one consisting of both temporal portions, or a broad one consisting of both nasal portions. It is *all important* to include small control marks *in this and in any other similar experiment*. A dot may be placed above one 8 and below the other. Without control marks fixation may be inaccurate, and when this is the case the 8 may appear displaced to one side or the other by an amount less than the displacement in either of the two diagrams. Inaccurate fixation does not necessarily produce diplopia of the 8's, because under these conditions one 8 may suppress the other.

By the use of variable prisms or other means the lock stimulus may be used to force unusual positions of convergence of the eyes. When this is done, the separation of the control marks from each other indicates that fixation is not accurately maintained upon the 8's. There is no need to invoke "retinal slip" to explain observations of this kind.

Fig. 2.

Small black disks, Figure 2, may be arranged with a disparity between the upper pair. This will give a depth effect, and careful observation of the position of the control marks will show that when only a single upper disk is perceived, this singleness results from the suppression of one of the upper disks without there being any change of correspondence.

DEPTH PERCEPTION WITH DIPLOPIA

In a dark room a steady light point is fixated. A single light source whose position may be varied is now placed nearer to or farther from the observer than the fixation light, and is made to give out a single flash. This is seen either in crossed or in uncrossed diplopia, and the observer can always tell whether the flash is nearer or farther than the fixation light. This shows that disparity is an effective clue to depth perception under conditions where there is no fusion of the disparate

Fig. 3.

stimuli. This result could not be explained on the fusion hypothesis, but it accords well with the suppression theory.

A binocular combination may be made of a pair of diagrams of the type shown in Figure 3. Here, not only is there disparity with diplopia, but the two diplopic images are not even the same shape; nevertheless the depth effect can be perceived. This effect was discovered by Lowenstein.

BLACK AND WHITE MIXTURES

A drawing in black on white may be combined binocularly with one in white on black, and results in an impression usually described as having "lustre." This is thought to be the result of a fine grain binocular mixture, so that the mental picture consists of black grains contributed by one eye closely interspersed with white grains from the other eye, and this result is held to support the suppression theory.

BINOCULAR COLOUR MIXTURE

In the case of binocular combination of red and green postage stamps, some apparent mixture of colours does appear to take place, and the result approximates brown. There are, however, two distinct reasons for supposing that this impression of a binocular mixture does not result from any fusion between pairs of corresponding points.

1. With any black and white line drawings it is easy to show that mis-focussing of one image will cause the other sharper one to become more dominant. If one of the coloured stamps be mis-focussed, the colour of the other sharper one will then be seen to predominate to an increased extent. This suggests very strongly that the difference in sharpness is altering the direction of the suppression of a large number of the points, and favours the view that the apparent mixture results from finely intermingled elements from each of the two retinas. This view was first put forward by Verhoeff.

2. If an electrode is placed in the optic nerve of an animal, then the number of impulses per second traveling along the nerve fibre is found to be approximately proportional to the logarithm of the physical intensity of the light stimulus. It is probable that the same is true for man.

Normal daylight is roughly 10^4 times above the threshold intensity of the light adapted eye. At this intensity there will be a certain number of impulses per second traveling up each nerve fibre. If the rate at which

these impulses arrived at the brain were to be effectively doubled by a confluence of the two visual pathways, then we would expect an impression of brightness to result which would be equal to that which would be produced by an intensity 10^8 times threshold, or 10,000 times daylight, acting on an eye which could tolerate and mediate this intensity.

However, very little, if any, increase in brightness accrues from the use of two eyes rather than one, so that any simple fusion of this kind is quite definitely excluded.

In the case of the postage stamps, since there is no increase in brightness, it seems that there is no fusion from corresponding points.

AMERICAN ACADEMY OF OPTOMETRY

ELECTED TO FELLOWSHIP

The following optometrists and educators have been elected to Fellowship in the American Academy of Optometry. The Academy welcomes these new members.

Mr. Geoffrey Vernon Ball, Dept. of Physics & Mathematics, College of Technology, Birmingham, England.

Dr. Frederick W. Blume, 43 Parkview, Logan, Ohio.

Dr. D. S. Goldschmidt, 129 N. Court St., Circleville, Ohio.

Mr. Robert Green, 13 Whickham Ave., Dunston, Gateshead, County Durham, Scotland.

Mr. Robert R. Hines, Victoria Chambers, 220 Wolverhampton St., Dudley, Worcestershire, England.

Miss Frances Jane Jackson, "Edgemount," Ballynahinch Road, Carryduff, County Down, Belfast, North Ireland.

Mr. Albert Johnson, 46-B Turner St., Blyth, Northumberland, England.

Dr. Carol B. Pratt, College of Optometry, Pacific University, Forest Grove, Oregon.

Dr. Harris Ripps, School of Optometry, Columbia University, New York City.

Mr. Stuart B. Whitehead, 3, Bridge St., Kakenham, Norfolk, England.

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COLUMBIA TO CLOSE UNDERGRADUATE OPTOMETRY PROFESSIONAL COURSE.

The recent announcement that Columbia University plans to terminate its undergraduate optometry professional courses is regretted throughout the profession. For nearly 50 years Columbia University has provided undergraduate professional education, and during this period several thousand well-trained optometrists have entered the profession from this school. These practitioners, along with the faculty in optometry at Columbia, have made many important contributions to the art and science of visual care. Naturally, if the school closes, much of this work will be continued elsewhere, but as a scientific center in optometric care and things germane to vision, Columbia will relinquish its place of leadership to other schools, and optometry indeed regrets this action.

This announcement, at this time, from the Trustees of Columbia University, came as no surprise to many. During recent years a number of problems have developed on that campus which made the continuance of the school doubtful. In briefest review, we find that former forceful leaders such as Dean Pegram and Professor Southall were in retirement and sorely missed. Student enrollment was down, and this raised the question of financial support, as Columbia is not a tax supported institution. Within and without the school itself there was no uniformity of thought on the proposed change over from five to six years of undergraduate optometry training. In addition, some medical opposition within Columbia continued and, last, the pressure of the "degree" question was plaguing officials who were already overburdened with many other more pressing problems.

Fundamentally, however, nearly all of the difficulties developed within the broad area created by a lack of genuine support of the school by the optometric profession itself. With strong loyal support (which was freely given by some optometrists, but withheld by many others) the school administrators could have easily solved the questions before them. Without such whole hearted backing, the job became more and more difficult, and the University authorities, sensing the general lack of professional support, eventually decided that their money and energies would be better used elsewhere, and the announcement of future closing became a reality.

Optometry stands to lose one of its fine educational centers. We believe this could have been avoided, and perhaps the situation can still be rectified by prompt local and country wide action.* In any event, the current announcement should serve to awaken optometrists everywhere to the pressing need for supporting, to the very fullest extent, their many remaining fine undergraduate optometry schools and colleges. And, it will also serve, we believe, to unite optometrists everywhere in a major effort either to reinstate or replace the School of Optometry, Columbia University, with another fine undergraduate optometry course in New York State.

CAREL C. KOCH

*As the forms close for this issue it is reported that Dr. James F. Wahl, president of the American Optometric Association and Dr. Harold M. Fisher, president of the New York State Optometric Association and past president of the American Academy of Optometry are arranging a conference with top officials of Columbia University to further explore the current situation.

SPECIAL REPORT

COMMENTS ON THE OPTICAL FAIR*

Carel C. Koch†
Minneapolis, Minnesota

There is something about a Fair that quickens the pulse. Fairs, like parades, attract great crowds and focus attention on special events. Throughout recorded history, Fairs have been held to stimulate interest in trade and science, and to place before those interested the newest ideas and developments of the day. Fairs are always educational and entertaining and our own Optical Fair will be no exception.

There have been Optical Fairs in Europe, but as far as we know, this is the first of its kind held in America. Our Fair is sponsored by the Optical Manufacturers Association and has a long and impressive list of exhibitors. It is safe to say that these American Manufacturers will assemble, in one great exhibition hall, samples of every important contribution made in this country for use in conserving vision.

A Fair of this sort has immense possibilities, and from advance reports, we believe that these will be developed to the fullest extent. On display will be diagnostic equipment, refractive equipment and instruments used to test the muscular anomalies of the eyes. Office furniture, cabinets, and other special equipment will also be exhibited. In addition, the immense variety of modern ophthalmic lenses will be displayed—each highlighting its own particular purposes and advantages. Laboratory supplies and equipment will also be on exhibit, and live test runs will be made in the exhibit hall to show the speed and accuracy of such laboratory pieces.

The frame manufacturers also will exhibit their attractive and unique wares at the Fair. It is safe to say that never before has such a profusion of up-to-the-minute frame styles been assembled in one great hall. Our frame manufacturers are world renowned for their ability to make colorful and stylish frames, and what is equaly important, to make them well so that the glasses we prescribe are not only properly held in place, but that they are also attractive and comfortable. Frames will be on display at the Optical Fair in every possible color, style and

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shape—and there will be frames for every purpose. To use "Fair" language—all these exhibits will be colossal and must be seen to be appreciated.

Chicago, Illinois, is the Optical Fair city for 1954. The Optical Fair will be held early in June. Optometrists and their families are invited to the great exhibit hall, Palmer House, Chicago, Illinois, June 5-10. It is expected that a large segment of the profession will attend and enjoy the hundreds of exhibits.

In welcoming and reviewing this special event, several observations may be made. The Optical Fair is an innovation in this country. Obviously, the Optical Manufacturers Association is hopeful for a sympathetic and warm response to its efforts and will quite naturally guage the future of this event on the reception given the 1954 Fair. If the Fair in Chicago is well attended, other Optical Fairs are sure to follow. As these Fairs have strong educational value and appeal, they should be encouraged and supported. We hope all optometrists, who can do so, will attend.

From the educational standpoint, future Optical Fairs might consider having a section of the exhibit hall devoted to purely scientific exhibits of precision optical instruments made in this country by our own exhibitors of ophthalmic equipment and materials. And, also, from the same standpoint more foreign exhibitors should be welcomed at future Fairs. Certainly American manufacturers have little to fear from foreign competition; yet, we, as optometric participants in the event would find foreign displays of interest through comparison with our own American exhibits. Scientific books, too, should be on exhibit.

And, discussing exhibits, brings us back to styles in glasses—isn't it about time for someone to bring back the inconspicuous and dressy rimless eyeglass, with either the finger-piece or Essex type nosepiece. Thousands of middle aged patients would welcome the return of the rimless eyeglass mountings—not to replace today's stylish utility spectacle, but as a change from these, as an extra pair of glasses.

And last—at future Fairs—why not invite the public to see the colorful exhibits? Certain evening hours could be assigned for this, and many people would come. No doubt this point was thoroughly discussed, and for the 1954 Fair discarded, during the long period of planning which preceded this year's event. However, from the public relations standpoint—in some future Optical Fair city—the wide spread attendance of many potential and present patients would stimulate additional interest in visual care.

To summarize—the big 1954 Optical Fair will be held at the

Palmer House, Chicago, Illinois, June 5-10. Optometrists and their families are urged to come and spend some time at this outstanding event. The Fair will be educational, stimulating and colorful.

And not only are optometrists from all States invited, but Canadian optometrists are also urged to come. The Optical Manufacturers Association will welcome optometrists from Canada and it is expected that a large number will visit the Fair.

For a review of some of the exhibits, readers are asked to turn to page 263 of this issue, where, in Current Comments—Terry Judith Parkins highlights some of the many things that will be on display.

The American Academy of Optometry welcomes the 1954 Optical Fair. It joins with others in hoping that this Fair will be successful and that it will be the first of a long series of similar successes.

THE EXHIBITORS, 1954 OPTICAL FAIR, CHICAGO

American Bifocal Co., Inc.
American Metal-Lux, Inc.
American Optical Co.
Armco Mercantile Co.
Artcraft Optical Co.
Bauch & Lomb Optical Co.
Better Vision Institute
Bishop Company, Inc.
Celanese Corp. of America
Century Oxford Mfg. Corp.
Coburn Mfg. Co.
Continental Optical Co.
E. I. du Pont de Nemours & Co.
Duroloid Optical Co.
Fairfield Optical Co.
J. Gaspari & Co., Inc.
Garvin's, Inc.
Harmony Optical Mfg. Co.
Hela Manufacturing Corp.
Hudson Optical Corp.
Imperial Optical Mfg. Co., Inc.
Kelley & Hueber, Inc.
Ketcham & McDougall, Inc.
Kono Manufacturing Co.
Erie Leopold
Liberty Optical Mfg. Co.
Lord Optical Mfg. Corp.
Lumar Optical Mfg. Co., Inc.
Marine Optical Mfg. Co.
Martin Copeland Company
Massachusetts Leather Prod. Co.
May Manufacturing Corp.
Modern Optics, Inc.
Monsanto Chemical Co.
New Jersey Optical Co.
Newport Optical Mfg. Co., Inc.
Nixon Nitration Works.
Nos-Ease Co.
Obrig Laboratories, Inc.
Optical Products Corp.
Opticase Corp., The
Pathway Opt. Co., Inc.
Precision Cosmet Co., Inc.
Raybert Corp.
Rochester Opt. Mfg. Co., Inc.
Rolled Gold Platers Assn.
Shuron Optical Co., Inc.
Soft-Lite Bay State Optical
Styl-Rite Optics, Inc.
Titmus Optical Co., Inc.
Tri-Zyl Optical Corp.
Tru-Vue Optical Corp.
Tura, Inc.
Universal Optical Co.
Univis Lense Company
Victory Optical Mfg. Co.
Vision-Ease Corp.
Vogue Optical Mfg. Co., Inc.
Ward Optical Corp.
Zylite Products Co., Inc.
Zylo Ware Corp.

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

REPORT OF FIRST WESTERN REGIONAL MEETING*

AMERICAN ACADEMY OF OPTOMETRY

Elwin Marg†
School of Optometry, University of California
Berkeley, California

The first Western Regional Meeting of the American Academy of Optometry was held on the campus of the University of California on April 10 and 11. The meeting was sponsored by the San Francisco Bay Area Chapter of the Academy. The committee on arrangements consisted of Dr. Merton C. Flom, Professor Elwin Marg, Dr. Darrell B. Carter, Dr. Sigmund Sabin, Dr. Gordon G. Heath, and Dr. Robert F. Harrigan.

The meeting was well attended; with 115 optometrists, ophthalmologists, and scientists registered plus approximately 60 students from the three schools of optometry on the west coast. The majority of those registering were from California; however, optometrists from the states of Washington, Oregon and Nevada were also in attendance.

The meeting was opened Saturday morning by a welcome from Dr. Darrell B. Carter, Chairman of the San Francisco Bay Area Chapter. Next, Dean Kenneth B. Stoddard of the School of Optometry brought the greetings and best wishes of the President and Chancellor of the University of California. Dean Stoddard also expressed his personal greetings. Professor Meredith W. Morgan, Jr., President of The American Academy of Optometry, brought the well wishes of the Executive Council of The American Academy and expressed the hope that this meeting would provide the inspiration that the national meeting does each year.

The formal papers program was presided over by Professor Elwin

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Marg, Chairman of the Papers Committee. The first paper of the morning was presented by Professor Gordon L. Walls of the School of Optometry of the University of California, "The Filling-In Process." Professor Walls advanced a hypothesis which explains, though only incidentally, the filling-in of the physiological blind spot. He pointed out that the filling-in of the blind spot and of scotomata which arise from occipital lesions could not be explained on a teleologic basis since frequently such filling-in must be disadvantageous to the organism. This filling-in must be something built in the visual system and must be a natural consequence of its organization. The fibers of the optic nerve have been shown to transmit only "on" or "off" messages or both. There are no fibers which transmit constant information of a steady state of illumination. As a consequence, only the borders of objects could be seen in visual space if the visual system did not fill-in. Borders are made more effective by the normal physiological nystagmus of the eyes. Thus a white sheet, illuminated in such a way as to carry a gradient of illumination across its surface, will be seen as uniformly illuminated if the gradient is gradual enough to create no borders. However, if a line is drawn on the sheet, immediately two differently illuminated areas will be perceived, one brighter than the other.

The second paper was presented by Professor Frank Weymouth of the Los Angeles College of Optometry, "Anisooxyopia (Unequal Visual Acuity) in Anisometropia." Professor Weymouth analyzed the corrected visual acuity of subjects with respect to refractive error and anisometropia. His analysis indicated that in subjects with either high myopia or high hypermetropia there was a slight decrease in the corrected visual acuity. This decrease was related to the degree of the ametropia. In myopia, however, even with anisometropia, the corrected visual acuity in the two eyes was similar but in the case of hypermetropia and, especially, in the case of hypermetropic anisometropia, one eye frequently had markedly poorer acuity than the other eye. Professor Weymouth suggested that hypermetropia could be interpreted as being a more serious problem than myopia.

The third paper, "Correlation of Tests for Ocular Dominance," was presented by Dr. Arthur B. Emmes of Castro Valley. His results indicated that there was a high correlation between eyedness and handedness but for small differences in visual acuity there was so significant correlation between visual acuity and eyedness.

Dr. Morris Kirschen of Modesto, California, next reported on a "Visual Investigations of Mentally Retarded Children—A Study." Dr. Kirschen found that mentally retarded children have a much higher

incidence of visual defects than do normal children. Approximately 18% had nystagmus, 20% had strabismus and nearly 80% had ametropias greater than 1.00 D.

"The Results of Prescribing Vertical Prisms from the Turville Test" was reported on by Dr. Ferd T. Elvin of Oakland, California. Dr. Elvin prescribed the full amount of the vertical prisms as disclosed by the Turville test for a series of patients. He found that the prescriptions thus determined were highly successful as judged on the basis of patient acceptance and comfort. There was indication that wearing vertical prisms was associated with some increase in the vertical heterophoria.

The first papers session was concluded with the presentation of "The Correction of Induced Prismatic Displacement—A Case Report" by Dr. Edward Goodlaw of Los Angeles. This was a case report of apparent improvement in performance attained by a hunter when a cement segment was added to his glasses which corrected for the prismatic displacement induced by looking obliquely up and in through his lenses when aiming his gun.

Saturday luncheon was enjoyed at the Faculty Club of the University of California. Immediately after luncheon, pictures and descriptions of the research activities and the general facilities of the School of Optometry of the University of California were presented.

The afternoon papers session was opened by the presentation by Dr. Richard Spencer of "Accommodative Response in Asymmetric Convergence." This paper was prepared by Dr. Spencer and Dr. W. Keith Wilson at the College of Optometry, Pacific University. Dr. Spencer presented evidence that in asymmetric convergence the accommodative response is nearly equal in the two eyes although not exactly equal. Two observers were used. One observer accommodated slightly more in the right eye, when the fixation target was displaced to the right, and slightly more in the left, when the displacement was to the left. The other observer behaved in the reverse manner.

Professor Harry Jankiewicz next reported on "A Six Generation Pedigree of Congenital Zonular Cataract." This study was made at the Los Angeles College of Optometry by Professor Jankiewicz and Dr. Dale Freeberg. It was determined that in this family the cataract was a simple autosomal dominant character.

"The Effect of Hyperventilation on the Human E. R. G." was read by Dr. Paul Eskildsen. This was a study made at Pacific University by Professor Mathew Alpern, Professor John Faris, Dr. Eskildsen and Mr. Paul Garnett. These investigators found that hyperventilation resulted in an increase in the b- wave and a decrease in the a_1 and a_2

waves of the E. R. G. They interpreted this to mean that under conditions of hyperventilation, the human E. R. G. assumes the characteristics of the response of the E retina rather than those of the normal I retina.

Professor Elwin Marg reported on a study made by him and Lt. Johnie L. Reeves at the Aero Medical Laboratory on the "Accommodative Response of the Eye of an Aged Cat to Electrical Stimulation of the Ciliary Ganglion." Professor Marg measured the accommodative response of a 15 year old cat with the aid of a Rodenstock Refractometer. He found the cat did not exhibit the reduction in the amplitude of accommodation which in man results in presbyopia.

Dr. Curtis Nagel of Berkeley then discussed "The Design and Development of a Contact Lens for Underwater Seeing." This lens was designed to replace the face plate normally worn by providing a flat anterior surface and an air space in front of the standard parascleral contact lens.

"A Quantitative Comparison of the Prism-Jump Method and the Tangent Screen Method of Plotting Scotomata" was presented by Dr. Charles Lawson, U. S. Army. He discussed a method proposed by Irvine some years ago for measuring suppression areas. Dr. Lawson found that the method was both reliable and valid for plotting scotomata.

Saturday evening a dinner was enjoyed by those attending the Western Regional Meeting. The informal dinner was served at The Hotel Shattuck. Professor Emeritus Ralph S. Minor of the School of Optometry of the University of California was the honored guest and was presented with an honorary membership in the San Francisco Bay Area Chapter of the American Academy of Optometry. The dinner speaker was Professor Frank Weymouth of the Los Angeles College of Optometry. Professor Frank Weymouth is a Professor Emeritus of Physiology of Stanford University. His topic was "The Nonagenary of Physiological Optics" in which he presented a thumbnail history of the great men in vision and the debt modern optometry owes these men. He pointed out that scientific refraction started ninety years ago with Donders. After dinner a fellowship period was enjoyed by all.

Sunday morning Dr. Louis Jaques, Sr., of Los Angeles, opened the third papers session by presenting his paper, "Hyperphoria Testing." Dr. Jaques pointed out the clinical importance of hyperphoria and its relationship to head tilting and cyclophoria. He also discussed the role of hyperphoria in producing asthenopia.

"The Appearance of a Hyperphoria Immediately Following Parturition" was presented by Dr. Marian K. Eakin and Dr. Robert S.

Eakin of Los Angeles. This was the clinical report of a patient who had unrelieved asthenopia for 14 years in spite of careful refraction and orthoptics. Soon after the birth of the patient's child a hyperphoria became manifest. When this was corrected the asthenopia disappeared and the patient was able to use her eyes without discomfort.

The third paper of the morning was a clinical study of "An Unusual Case of Double Monocular Diplopia" by Professor Meredith W. Morgan, Jr., of the School of Optometry, University of California. This was a study made of the visual functions of a patient with monocular diplopia which was present for each eye in the whole field of view except for the central 3° of the field. The diplopia had a sudden onset. The patient had previously been exotropic. The diplopia, however, was not the usual type of diplopia associated with anomalous correspondence in squinters.

Dr. Merton C. Flom of the School of Optometry, University of California, next presented "A New Method for Measuring the Angle of Squint and the Angle of Anomaly." This method is a modification of the Hallden technique and is based on the labeling of the fovea of the deviating eye with an after-image. The method can be used with a major amblyoscope or with twin projectors. It allows for the direct and separate measurement of the subjective angle, the objective angle, and the angle of anomaly.

Dr. Max Schapero of the Los Angeles College of Optometry then presented a report outlining "The Effect of the A.C.A. Ratio and Changes in Fixation Distance on the Angle of Anomaly—A Preliminary Report." This paper was co-authored by Professor Frank Weymouth and Dr. Margaret Hester. Dr. Schapero pointed out the problem that arises if a squinter with anomalous correspondence maintains the convergence based on his A.C.A. ratio. This would mean that harmonious anomalous correspondence exists for all fixation distances only when the A.C.A. ratio is 6△/1.00 D. It has been Dr. Schapero's clinical experience that a large number of squinters subjectively display the same angle of squint at distance and near. This could be interpreted to mean that squinters make a "fusion-like" movement to maintain the same angle of anomaly.

During the luncheon recess there was an opportunity to tour the School of Optometry Building of the Berkeley Campus of the University of California.

Immediately after lunch a business meeting was held. It was decided that The Western Regional Meetings should be continued and that the second meeting will be held in Los Angeles in April or early May of 1955. The host Chapter will be The Southern California

Chapter of the American Academy of Optometry.

The fourth papers session was opened by Dr. Arthur Jampolsky of San Francisco who described the "Differential Characteristics of True Exophoria and Intermittent Exotropia." Dr. Jampolsky pointed out that the degree of the deviation does not determine whether patients were exotropic or exophoric. The chief characteristic of those with intermittent exotropia was a suppression area in the temporal retina of the deviating eye.

The meeting was continued with the presentation by Professor Mark Rosenzweig of the Department of Psychology of the University of California of the "Contrasts Between Vision and Audition." Professor Rosenzweig called attention to the extreme sensitivity of both the eye and ear and the wide ranges of stimuli to which they are sensitive. He discussed the possibility of decreasing the load on vision in aviators by using various sounds to convey information now obtained visually. There is at present a method for visualizing sound which is proving an aid to those who are deaf. Experiments in changing visual stimuli to sound lead to the hope that this process may be used in the future to aid the blind.

Dr. Gordon Heath of the School of Optometry discussed "Accommodative Responses in Subjects With Low Visual Acuity." Dr. Heath has found, using three subjects, that totally color blind individuals give accommodative responses to optical stimuli which resemble the responses reported in normal nocturnal myopia and nocturnal presbyopia. Dr. Heath investigated the accommodative responses of a subject with amblyopia and of normal subjects made artificially amblyopic by putting a diffusion disc before one eye. The accommodative responses were found to be similar to those of the color blind subjects. It would thus appear that accommodation is related to the absolute level of possible resolution—one does not change his accommodation unless better resolution can result. The eye under conditions of poor resolution acts like a fixed focus camera set for a distance of about two-thirds of a meter.

The concluding paper, "Testing Aniseikonia with a Simplified Space Eikonometer" was presented by Dr. A. Harry Malin of San Diego. Dr. Malin described a space eikonometer which he had constructed himself. He reviewed the symptoms of aniseikonia and then discussed briefly the importance of small differences in image size. He found that his technique gave results similar to those reported in the literature for commercially manufactured instruments. He concluded his report with a summary of his clinical experience which indicates that aniseikonia is an important clinical entity which should receive far more attention from optometrists.

CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

YOUR 1954 OPTICAL FAIR

What are we going to see at the 1954 Optical Fair in Chicago? Well, we haven't all the news, but our friends around the country have sent in many items of interest which will give you an idea of the size of this event.* Of course, in addition to those things mentioned here, there will be many other new features too—so, you owe it to yourself and your practice, to go to Chicago—June 5-10, Palmer House—The Optical Fair, and see for yourself. Here are some of the items—

Art-Craft Optical Company will feature The Banker, a new all metal 1/10-12K gold filled frame for men. Sharing honors will be the Art-Brow Leading Lady Clarbridge frame with crystal-clear bridge against contrasting colored zyl fronts. Other special *Art-Craft* frames will feature the Royal Baguette trim. A new children's frame, The Ranger, will be presented for the first time at the Fair, and, in addition to this, their exhibit will present the new colored Townsman All-Zyl Clarbridge frames for men.

According to M. G. Bertelstein the exhibit of the *Univis Lens Company* should also prove of great interest to those attending the Fair at Chicago. The company will have as its main theme of exhibit, extensive data and findings from *Univis* research people. Visitors will have the opportunity to see new technological developments in lens making and new products to come from this research. Demonstrations will be made at the exhibit and literature covering new lens developments will be available.

Vincent Salierno, the peppy president of the *Victory Optical Manufacturing Company* has announced that they will exhibit the new Victoria line of seven frames in 44 different color combinations. These frames are made of laminated thermoplastic acrylic resin, called Vicrylite—strong and good looking when made into a frame. *Victory* will also display its line of zyl frames featuring the Visa and the ever popular Honey, plus the new frame made especially for men, the Sinclair.

*See page 254 of this issue, "Comments on the Optical Fair" by Dr. Carel C. Koch.

The B.V.I., too, is going to have a booth and a display of materials and aids they use to focus attention on conserving vision. M. J. Julian will be in charge. He is president of the *Better Vision Institute* and during the Fair he will release the results of the survey now being conducted on eye-care and its future needs,—and he will probably also announce a plan for doing something fine and constructive to stimulate more and more visual care in the future.

According to Katherine Cleaver, the *Continental Optical Company* are highlighting three of their top specialities—the first is their Ultex line of bifocals and trifocals—next the Kurova lens line with their corrected curves,—here sight, sound and motion will be used in this section of the display, and last their special group of spectacle frames featuring Zylcrest. The exhibit will have unique lighting and sound features and will also present a 3D binocular viewer of fashion models wearing *Continental* frames and mountings.

Bausch & Lomb are equipping a modern refraction room to display their entire line of ophthalmic instruments just as they would be used in every day practice. Of particular importance will be a new hand ophthalmoscope shown for the first time. In addition, according to D. H. Hicks, in other sections of their space they will feature their orthogon ophthalmic lenses, pointing up to their new Panoptik Functional Trifocals. Frames, too, will be shown including the new colored Hi-Lite. They will also have on display their complete line of optical machinery. The *Bausch & Lomb* exhibit will cover five exhibit booths.

According to W. J. Murray, Jr., *Universal Optical Company* will introduce two new frames at the Fair. At the time this department was written the details on these two new frames are under wraps. However, in addition to these, *Universal's* exhibit booths will feature the Manbrow, Mansfield, Milford, Fairfax, Rimway and most popular Numont lines of spectacle frames. You will have to come to Booths 46-47 to see the two new frames for yourself.

The *Shuron Optical Company* will have seven booths in the center of the exhibit hall. Here they will feature a complete line of laboratory machinery, all in operation. According to C. H. Mallery, it will be a visual demonstration of the *Shuron* surfacing system. In addition the new spectacle case "Two-Suiter" idea, which implements the professional visual program will be featured along with the new Ronman frame, the Ronartte mounting and the very popular Brow-line group of frames.

Titmus Optical Company will show a complete line of lenses, frames and Cabana Sun Glasses. According to E. P. Sweeney the exhibit

will feature the latest developments in lenses, including the 25 mm. straight top bifocal and the 7x25 mm. trifocal. Shown also will be the corrected curve lens series, both white and absorptive. Another feature of the *Titmus* exhibit will be the display of the Starr frame line including all 14 colors and patterns with a new assortment of harmonizing temples and trims. A new, surprise frame will also be shown.

The *Martin-Copeland Company* plans to exhibit the production steps necessary in making the Marlene Fashionframe. This new frame, with its upcurving styling is made in both pink and white 1/10-12K gold-filled metal with zyl tipped temples. The frame is nicely engraved. *Martin-Copeland* will exhibit in booth 63.

Irving Hirschman, president of the *Hudson Optical Corporation* points out that their exhibit will feature the stylish new Si Bon frame with its removable eyewires and 1/10-12K gold filled bridge, giving this new number great beauty, flexability and ease of adjustment. *Hudson* will also display the new Lady Hudson frame with black or scarlet filigree zyl trim.

According to George A. Anderson, Director of Public Relations, *American Optical Company* will exhibit a number of important laboratory machinery items, including automatic lens grinders with new technical innovations and a new lens marker and cutter. The *American Optical Company* will also introduce a new spectacle frame and a new type of open-end case, and their booths will also include a live demonstration showing various Tillyer lens types and their uses. John V. Cockin, of their *Buffalo Instrument Division*, also tells us that a complete line of A0 diagnostic and refractive equipment will be on display at the Fair.

Al Anderson tells us that the *Precision-Cosmet Company, Inc.*, will exhibit contact lenses; artificial eyes; a new children's trial frame, and a lens hardening unit they think is tops. The *Duroloid Optical Company* will exhibit "Four Seasons," an ingenious development in eye wear, while Marcelle O'Orsay points out that the *Nos-Ease Company* will have the most complete line of spectacle comfort products ever offered, at their exhibit. The *Armco Mercantile Company* will exhibit the Omnitrainer—an orthoptic training instrument, and the Magnocular —a telescopic spectacle unit made to aid sub-normal visual cases. They will also display the Mor-Vue Fitting Table Fixture.

The *Zylo Ware Corp.* exhibit will feature the new Twin-Spec—the frame with 14 advantages and convenience features for patients. It is available in sizes for both women and men patients. In addition,

the two-tone Reporter, Pompei and Monte Carlo frames will be on display in wine-and-pink and black-and-crystal. These new frames and the Blossom, Picturesque, Lovely and Excellency will be shown at the Fair by *Zylo-Ware*.

Bill Coburn of the *Rocket-Coburn Manufacturing Company* will exhibit his optical generating machines for cutting concave and convex surfaces, and also a new block cleaning unit for use in laboratories. And Fred S. Henley of the *Hela Manufacturing Corporation* will exhibit a line of plastic and soft leather cases, while Harriet Raymond of the *Celanese Corporation of America* tells us that her company will exhibit a new flame resistant and color stable plastic, for frame making, called Lumarith. This new material has had a two year trial run in frame making and she claims the new material eliminates the old necessary curing process. More than 30 frame makers now use Lumarith.

Martin T. Gullen tells us that the *Rochester Optical Manufacturing Company* will introduce a new Romgold Rimless frame, this being a combination frame with a gold bridge and half eyewires giving the patient an unobstructed view through the bottom of the lenses. They will also introduce at the *Rochester* booths a new Goldflex frame of metal and zyl.

O.P.C.—an old name in frame making, will be found in booths 81 and 82. W. R. Grossman says their exhibit will be built around a new frame called The Lark. If its as good a frame as the San Francisco-Los Angeles train by the same name it will be okay. *Optical Products Corporation* will also exhibit the new lines of the Riviera Heavyweight frame for women.

The Matador will be the featured frame at the *Ward Manufacturing Company* exhibit according to Frank J. Magher. They will also exhibit a group of children's frames under the names of Colt, Miss Pennay and Miss Wardette. And *Ketchum & McDougall* will exhibit their new line of Spec Grip Eyeglass Holders. This new holder has gold plated spring clips (rubber lined) that can be fastened anywhere on the frame, instead of the former rubber tubing clasps. These new holders are said to be very attractive. You can see them in booth 28.

According to E. R. Siehl the *Vision-Ease Corporation* will exhibit a new cataract bifocal lens with an 18 mm. flat-top segment in a 32 mm. field. Made in a new manner this lens is less costly than heretofore and the saving is being passed on to the patient. In addition *Vision-Ease* has developed a new temporary cataract bifocal designed to be loaned to the patient during the period when the power and correction are changing. Emanuel Nathan of the *Opticase Company* will show a new line

of cases and also exhibit the manufacturing steps from raw materials to finished products in case making.

These notes on some of the exhibits will give you an idea of the size and extent of the 1954 Optical Fair. In all there are more than 60 producers taking part and the Fair will be a real surprise to every optometrist who attends. Plan now to join us in examining and studying this vast display of optometric things. Come to the Fair at the Palmer House, Chicago, June 5-10. Bring your family. There is no registration charge and the Optical Manufacturers Association welcomes you.

EDUCATORS TO MEET IN SEATTLE AND FOREST GROVE

The Association of Schools and Colleges of Optometry will meet in Seattle, Washington, on June 23, this being the last day of the annual meeting of the A.O.A. in that city. At the conclusion of this one day meeting the educators will move to Forest Grove, Oregon, for the final two days of their annual meeting which will be held on the campus of Pacific University at the College of Optometry. Dr. Henry W. Hofstetter, Division of Optometry, Indiana University, is president of the Association of Schools and Colleges of Optometry.

EDUCATIONAL PROGRAM AT A.O.A. CONGRESS

The educational program at the annual Congress of the A.O.A. at Seattle will consist of three panel periods. The first of these, Sunday afternoon June 20, will deal with aspects of children's vision. The speakers on this panel are, Dr. Lois Bing, Cleveland, Ohio, Chairman, A.O.A. Committee on Visual Problems in Schools; Dr. Ross Hamilton, Director for Handicapped Children, Washington State Department of Public Instruction; Mrs. Leone Cummings, remedial reading specialist, Annie Wright Seminary, Tacoma, Washington, and Dr. Charles Margach, Director of Clinic, College of Optometry, Pacific University, Forest Grove, Oregon.

The second panel, also Sunday afternoon, June 20, will deal with private and public health plans. The speakers on this panel are, Mr. Harold Kohn, New York City, legal counsel for the A.O. A.; Dr. Elmer Westland, Ambridge, Pennsylvania, chairman A.O. A. Committee on Occupational Vision; Professor Don Hayne, University of Washington, College of Business Administration, and Mr. Fred Zellinsky, Administrative Director, Washington State Federation of Labor.

The third panel, Wednesday forenoon, June 23, will deal with Motorists' Vision. The speakers will be, Mr. Paul W. Siebert, managing director, Seattle-King County Safety Council; Dr. Kenneth H. MacPherson, Stockton, California, A.O.A. Committee on Motorists'

Vision: Mr. John C. Kerrick, manager, License Division, State of Oregon, and Captain J. D. Whittall, head of the Washington State Highway Police Patrol.

NEW A. O. A. FILM

The American Optometric Association motion picture, "More Than Meets the Eye," is now being filmed at the School of Optometry, Columbia University, New York City. The scenes will depict the major phases of an optometrist's education. The film opens in an optometrist's office and a flash-back to the school occurs when the conversation in the refracting room gets around to the matter of a career in optometry.

Dr. H. Ward Ewalt, Jr., Pittsburgh, is technical consultant for the production. John C. Patterson, New York City, A.O.A. public relations counsel, is in charge of the project. Eric Cripps, New York City, is the producer. The film will run for 26 minutes. The first showing is planned for the Seattle Congress of the A. O. A. in June.

ACADEMY CALL FOR PAPERS

Dr. John D. Perry, Winston-Salem, North Carolina, Chairman of the Papers and Program Committee of the Academy, has issued his "Call for Papers" to members who wish to prepare and present papers for the annual meeting of the American Academy of Optometry, at the Royal York Hotel, Toronto, Ontario, Canada, December 11, 12, 13 and 14, 1954. Members wishing to present material should contact Dr. Perry at once.

NATIONAL ACADEMY OF SCIENCES

Dr. Brian O'Brien, vice president for research of American Optical Company, Southbridge, has been elected to membership in the National Academy of Sciences at its recent meeting in Washington, D. C. Dr. O'Brien is one of the world's authorities in the field of optics. He was formerly director of the Institute of Optics at the University of Rochester, and president of the Optical Society of America.

BOOK REVIEW

THE GEOMETRY OF BINOCULAR SPACE PERCEPTION. LeGrand H. Hardy, Gertrude Rand, M. Catherine Rittler, Albert A. Blank and Paul Boeder. Knapp Memorial Laboratories, Institute of Ophthalmology, Columbia University College of Physicians and Surgeons, New York, p. 68. 1953.

In 1947 there appeared a slim paper-bound volume entitled "Mathematical Analysis of Binocular Vision" written by a mathematician named Rudolf Luneburg. After a brief introduction, Luneburg immediately plunged into a discussion of sensation in terms of set theory and then developed the concept of a metric of visual space, a concept which, incidentally, Mach had considered and rejected nearly fifty years earlier. Luneburg's subsequent efforts to show that visual space is characterized by a hyperbolic metric appeared remarkably convincing and the highly skilled mathematician found little trouble, it is hoped, in following his presentation. The mathematically naive worker in physiological optics could do little more than read the introduction and the conclusion, marvel, and await further developments. The hardest hit by the appearance of Luneburg's monograph were those interested in space perception who also had some degree of training in higher mathematics. Many of them, like your reviewer, felt that Luneburg's work was of the greatest import in the theory of space perception but since their mathematical background was not wide enough to allow them to fully follow Luneburg's writing, lucid though it may be, spent weeks, months, or years, depending on their perseverance, extending their knowledge of mathematics.

In spite of the esoteric nature of Luneburg's work it created an immense amount of interest. His original papers did not include any specific experimental work but were based on observations of Helmholtz, Hillebrand, Blumenfeld, and Ames. Under an Office of Naval Research contract, experimental work was begun in the Knapp Laboratories of Physiological Optics of Columbia University to provide further bases for a theory of space perception along Luneburg's lines. The report reviewed here is the outcome of these efforts. Unfortunately Luneburg died in 1949 and thus only contributed to the early stages of the research. Much of the final formulation, which differs in many significant details from Luneburg's original version, is due to A. A. Blank, a young mathematician from Courant's Institute in New York University.

Luneburg, in a posthumous paper published in 1950, had raised a number of further points in connection with his original formulation

and developed the theoretical structure for the experimental verification of his theory. These have now been tested in the laboratory and have led to what is probably the final official version of the theory, the research team having been in part disbanded.

The main change in the theory is the substitution of a more general distance function $r(\Gamma)$ in place of the originally proposed $\exp(\alpha\gamma)$. The expression of the results of several experiments—involving equidistant and parallel alleys, equivalence of sensed distances, etc.—in the relatively simple form of a monotonic function of binocular parallax is a tribute to the ingenuity of the mathematicians involved.

The report contains an extensive mathematical introduction which will again provide an almost unsurmountable obstacle to all but the mathematically sophisticated. Even the agility of the latter is tested by such a phrase as "It is clear that the quantity on the left of equation 25 must be greater than 1 if ω is to be a real quantity" (page 27) when what the authors actually mean is not the left of equation 25 but the right of equation 26.

The experimentalist will naturally turn to the second section of the report containing the results of a number of experiments involving the setting of light points in a dark room to several criteria. We have results once again showing that equidistant and parallel alleys do not coincide. Luneburg's original theory hinged on this, since it is a phenomenon most readily described in terms of a non-euclidian metric for visual space. Several other experiments involving sense distances and partitions are described and analyzed to yield a specification of the metric of visual space along the lines laid down by Luneburg.

In the report consideration is given largely to those aspects of the experimental results which can be best integrated into the mathematical framework already proposed. This is only natural.

There are, however, a number of aspects that these and other experimental results imply, and that cannot so readily be integrated into the structure elaborated by Luneburg, even as extended in the present report.

Many of these points are doubtless irrelevant and others can be simply explained as boundary conditions and hence in reality contained within the theory. Many more, such as possible changes in the distance function with changes in elevation, could be encompassed by further extensions of the theory and the development of more and more elaborate distance functions. Luneburg's theory, however, had its strongest appeal in the economy of parameters used in what looked like an adequate description of a worth-while range of an individual's visually mediated responses. To the degree that the description provided is found not to

be accurate or the number of parameters required continues to increase, such a theory loses stature.

This reviewer found many more interesting aspects of the report. Is it, for example, a valid procedure to reject experimental data because the subject did not appear to understand the task? Without question some subjects may have difficulties in differentiating between the concepts of equidistant and parallel alleys. This raises the question of the role of geometrical experience in space perception of even the most primitive kind. The line between this problem and the many pseudoproblems associated with and stemming from Kant's apriorism is admittedly vague, yet can it be ignored?

Even if all these points are satisfactorily resolved—and there is a real doubt whether they ever will—there still remains the task of applying Luneburg's theory to stimulus configurations other than dim point sources in an otherwise completely dark visual field.

It is at this point that an understanding of the real nature of Luneburg's theory is necessary. This is admirably presented by Ratoosh and Graham* who point out that the theory is merely a formal account based on a mathematical model; it is a set of mathematical functions providing appropriate transformations to relate the subject's settings in the dimensions of euclidian object space to a controlling magnitude of standard stimulus. It does not *explain*, it *describes*.†

The success of such a theory depends on how large a segment of responses it can describe, how accurately it does so, and with what degree of economy of parameters. Luneburg's theory has been particularly appealing in connection with this last point. But so have several other formulations in the history of psychophysics all of which lost in stature when more detailed experimentation revealed the limited range of their accurate description of the phenomena to which they were supposed to apply.

Is Luneburg's theory then destined to go the way of Weber's law? Historical perspective would incline one to this belief and there is nothing in the present report to dispel it.

Yet it would be wrong to condemn the brilliant mathematical insight and the patient experimental efforts that went into this work merely because it does not appear to be the final irrevocable answer to all

*P. Ratoosh and C. H. Graham. Review of *Mathematical Analysis of Binocular Vision* by Rudolf K. Luneburg. Psychol. Bull., 49:363, 1952.

†Ratoosh and Graham here refer to the distinction made in modern psychological theory between intervening variables (descriptions) and hypothetical constructs (demonstrable mechanisms). See, for instance, MacCorquodale, K. and P. E. Meehl. On a distinction between hypothetical constructs and intervening variables. Psychol. Rev., 55:95, 1948.

the indescribably complex questions of space perception. It has, after all, resulted in a host of new experimental data and in the development of a mathematical structure that may well be the prototype of many more.

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I. E. S. RECOMMENDED PRACTICE FOR RESIDENCE LIGHTING. Published by the Illuminating Engineering Society, 1860 Broadway, New York 23, New York. 44 pages. Illustrated. Board covers. $1. 1953.

A new guide for home lighting, the "I. E. S. Recommended Practice for Residence Lighting" has been published by the Illuminating Engineering Society. The 44 page illustrated guide was prepared by the I. E. S. Committee on Residence Lighting.

The new monograph is devoted to the basic lighting requirements for family activities involving near-point vision, such as the selection and placement of portable lamps for sewing, reading, desk work, piano playing, kitchen and laundry activities. Desirable types of table and floor lamps for such activities are shown, and accurate measurements as to their position with respect to the work and use are given in inches. Types of installed lighting fixtures for living rooms, dining rooms, bedrooms, kitchens and bathrooms with directions for obtaining maximum efficiency and value are included. The monograph also covers lighting of special areas such as playrooms, closets, porches and outdoor areas. Each of these lighting problems receives full treatment in the monograph and most are illustrated to show how the completed lighting job looks.

The book also contains other information vital to home lighting. Table I provides illumination values for residences for both specific visual tasks and general lighting, and the recommended footcandles for each. Table II furnishes details as to the appearance of each of the colors under two different types of illuminant, their Munsell color designations and reflectance percentages. Table III provides dimensions of portable lamps. Table IV, room description in total area and Table V, for linear wall lighting with fluorescent equipment. A color-chart is also provided.

This monograph is prepared in an interesting style, complete with subject index and appendix. It will serve as a valuable guide to optometrists concerned with home lighting and as an aid to the visual comfort of their patients.

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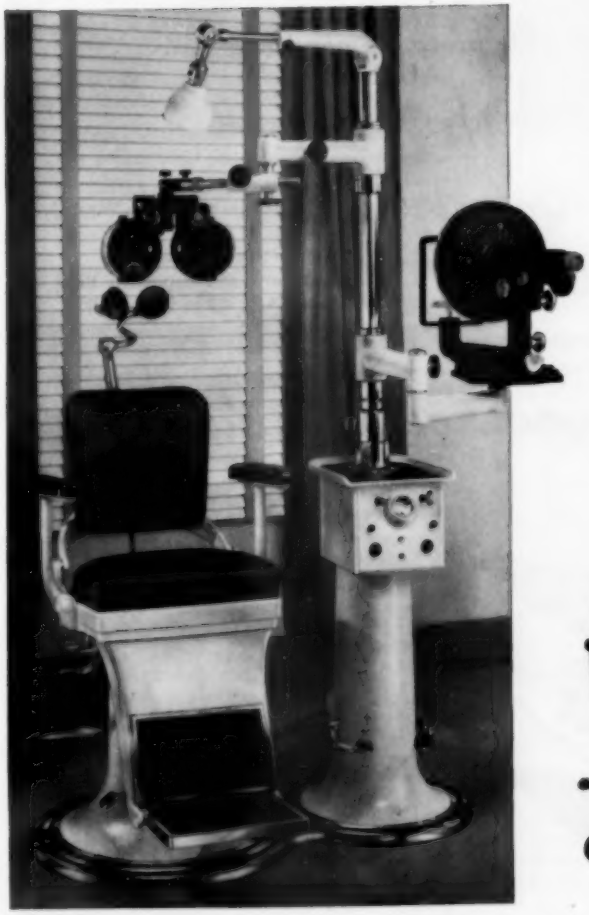

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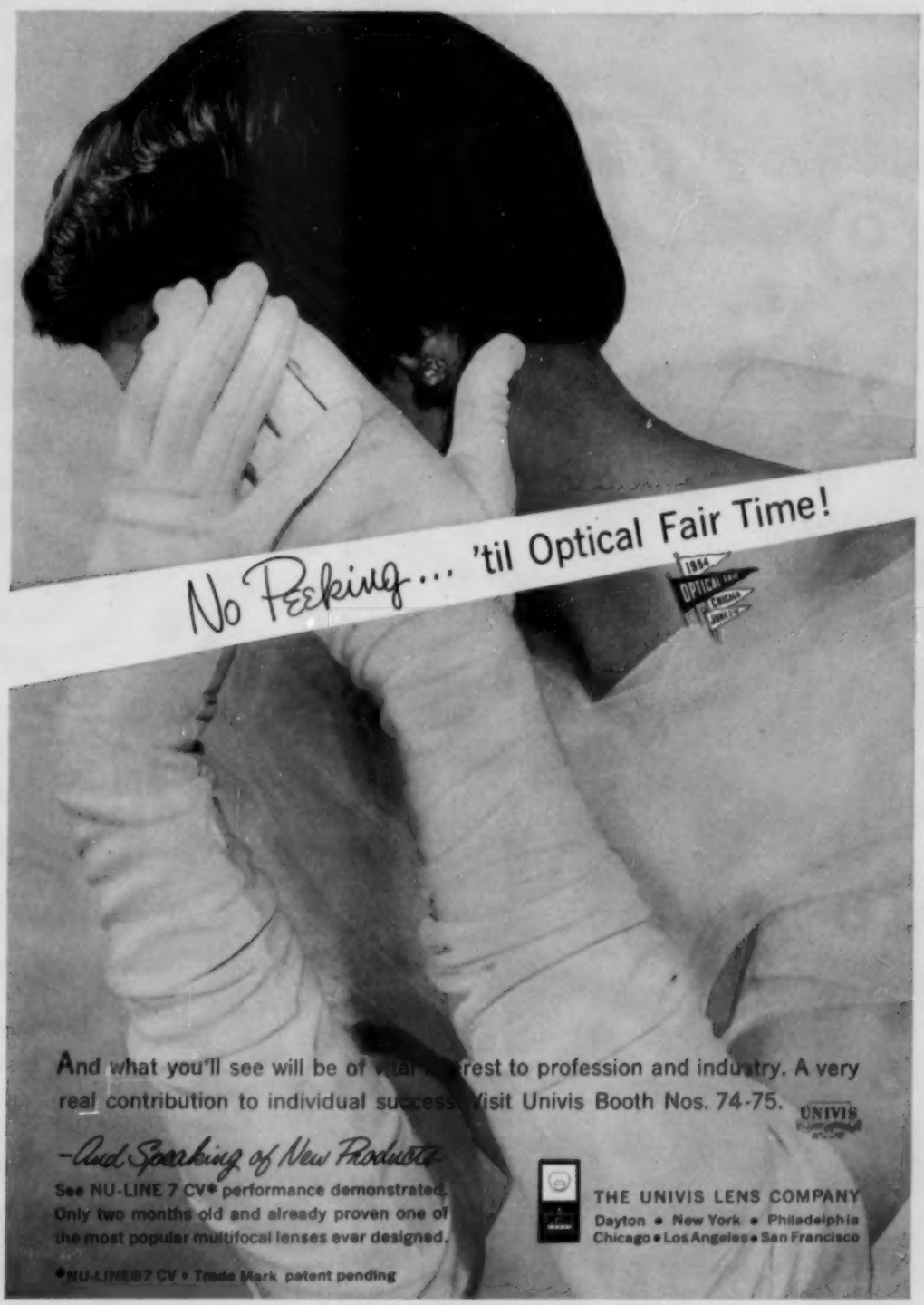
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